Policy Making in the field of Urban Gardens and Agricultural Lands' Preservation

Inaugural-Disseration
zur
Erlangung des Doktorgrades
Dr.phil.

der Fakultät
für Geisteswissenschaften
an der
Universität Duisburg-Essen

Vorgelegt von

Parisa Arjmandabbasi
aus Teheran/Iran

Juni 2015

Betreuer: Univ.-Prof. Dr. Hans-Werner Wehling
Fakultät Geisteswissenschaften

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Gutachter: Prof. Dr.-Ing. Alexander Schmidt
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1 Research Overview

1.1 Introduction and the necessity of research

The green areas of Tehran as the main natural resources of the city have constantly been destroyed by different economic, ecological, social and legal factors. From 1955 to 2000 more than half of the urban gardens and three quarter of the farmland have disappeared in Tehran. This amounts to more than 15,000,000 m^2 of gardens and 58,000,000 m^2 of farmlands. Due to new acts and regulations of the municipality on selling density and land use conversion to cover the city expenses this procedure has worsened since 2000. At the same time, the population has increased from 1.51 to 7.02 million people. As a result, the city authorities are confronted by complications to provide Tehran with sufficient urban services, infrastructures, food and natural resources. One of the consequences of this negative cycle has been air pollution. In 1999 the Department of the Environment of Islamic Republic of Iran announced that the costs of Tehran's Air Quality improvements have been estimated to be $ 1.9 billion in a 10 year plan. The annual indirect costs of air pollution are calculated to be $ 424 million, and taking into account the World Bank interest the indirect costs reaches to about $ 6 billion. It is estimated that about 27 people die each day in Tehran from pollution-related diseases. According to local officials, 3,600 people died in a single month due to the hazardous air quality. Deaths related to air pollution in Tehran is estimated to be 5.7 percent of all deaths in the same year. It is estimated that every dollar spent on air pollution control saves $ 20 in health care cost.

Moreover, it has to be mentioned that according to the Climate Change Performance Index (CCPI) Iran is on the list of the ten largest CO_2 emitters. These countries account for more than 60 percent of global emissions. Therefore, their future willingness and ability to pursue a sustainable climate policy is a requirement to avoid a highly dangerous level of climate change. In addition from 2008 to 2013 the overall results of climate change performance index in Iran has decreased so dramatically each year that in 2013 Iran ranked 60th between 61 countries.

The socioeconomic effects of the lack of green open spaces in the city, the huge change in the appealing image of old Tehran and the psychological impacts on people's lives are side effects which have been forgotten in comparison to the serious irreversible impacts the green land destruction has brought to the city. Most of the people have lost the emotional connectivity to urban ecology and the place they live; they can hardly adjust the new image of Tehran to their memories. The fast undeveloped spatial organization which stems from the rapid population growth and the considerable migrations to the capital has decreased people's local identity. This change has caused the formation of the new city centers and activity spaces in contrary to the approved urban plans. The new developments do not consider the green areas as an integrated part and are more focused on providing the living or activity space for the growing population. Thus, the green spaces have become a separate part of the urban plans with a weak position and a low priority. All mentioned social factors weaken the people engagement/participation in green preservation which makes this procedure even harder.

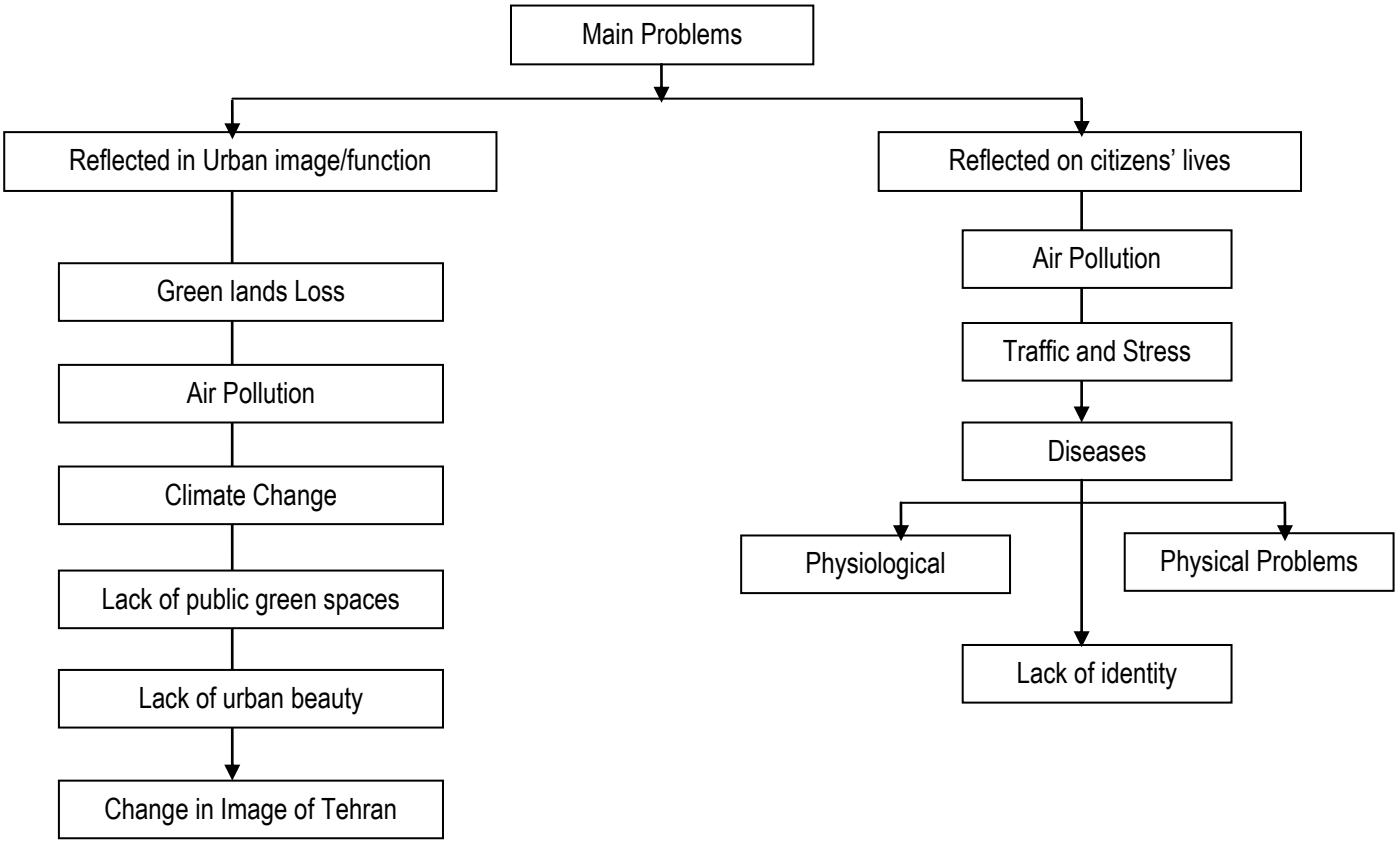
On the other hand, land price has increased dramatically in the last decade in Tehran and land speculation itself, especially in the regions with higher amounts of green areas have been one of the reasons of green lands destruction as well. According to the statistics of the Roads and Urban Planning Organization of Tehran, the apartment price in region 1 which is considered as the greenest region has increased 110 times from 1991 to 2013; whereas in the entire Tehran this amount has increased by 87 times. The average land or apartment price of this region is almost twice as much as the average of Tehran. Beside other unique social factors of this region, this shows the fact that the accessibility to the green areas in Tehran has gained a new ecological-economic value. These statistics show that Iran, especially the metropolitan area of Tehran requires more knowledge, research and improvement in urban ecology and this highlights the necessity of conducting a study to keep the resources remained. The study cannot turn back the loss but can decrease the speed of the destructive cycle in the first phase, may stop it in the second one and might create more green lands to compensate the loss in the

final one. Thus, to overcome all the problems in this complicated urban system a multidimensional and interdisciplinary approach is required to see the system elements from different aspects.

1.2 Main problem and related research questions

The main problem which highlights the importance and necessity of the current research is within series of sub-problems which will be explained the coming sections and could be summarized as figure 1.1.

Figure 1.1:The series of problems which highlight the research necessity



Source: The author

The research questions which are extracted from the series of problems mentioned above, have been developed and altered during the research process. There were three main initial questions in the beginning of the research. The first one stated was, what are the urban criteria which can end a garden or farmland life? At the same time the second question was to find out if an organization or a set of organizations cooperating in the field of "Conservation" in different government levels can be crucial as an action to prevent gardens and agricultural lands from disappearing. And the last but not the least was how a garden or farmland conservation can be economically justified.

As the research process went on, the questions turned to be as follows (Chronological sequence):

In the very first question just urban criteria have been taken in to consideration. But because urban studies require interdisciplinary research, different fields of study entered the research content and the first question was developed as: What are the criteria derived from different fields of study (economic, social, urban, management, laws and regulations) which accelerate green lands destruction or their sustainability? This question includes

another crucial point which is not just to find the result of green lands destruction but also trying to determine the reasons why some of them survive for a longer time than others.

At the same time the second question developed by the perception that it should not just be an organization but "an urban management structure" in different governmental management scales whose duty is not just to promote but to expand tasks as to develop preservation plans, set policies, make decisions or execute monitoring. Therefore this question has been developed to: Can an urban management structure in different governmental management scales cooperate for these tasks.

The third question has been completed likewise during the time with more precise statements as how can garden or farmland conservation be economically justified by means of exploring a set of economic programs and combining them with the policies?

1.3 Research goal and objectives

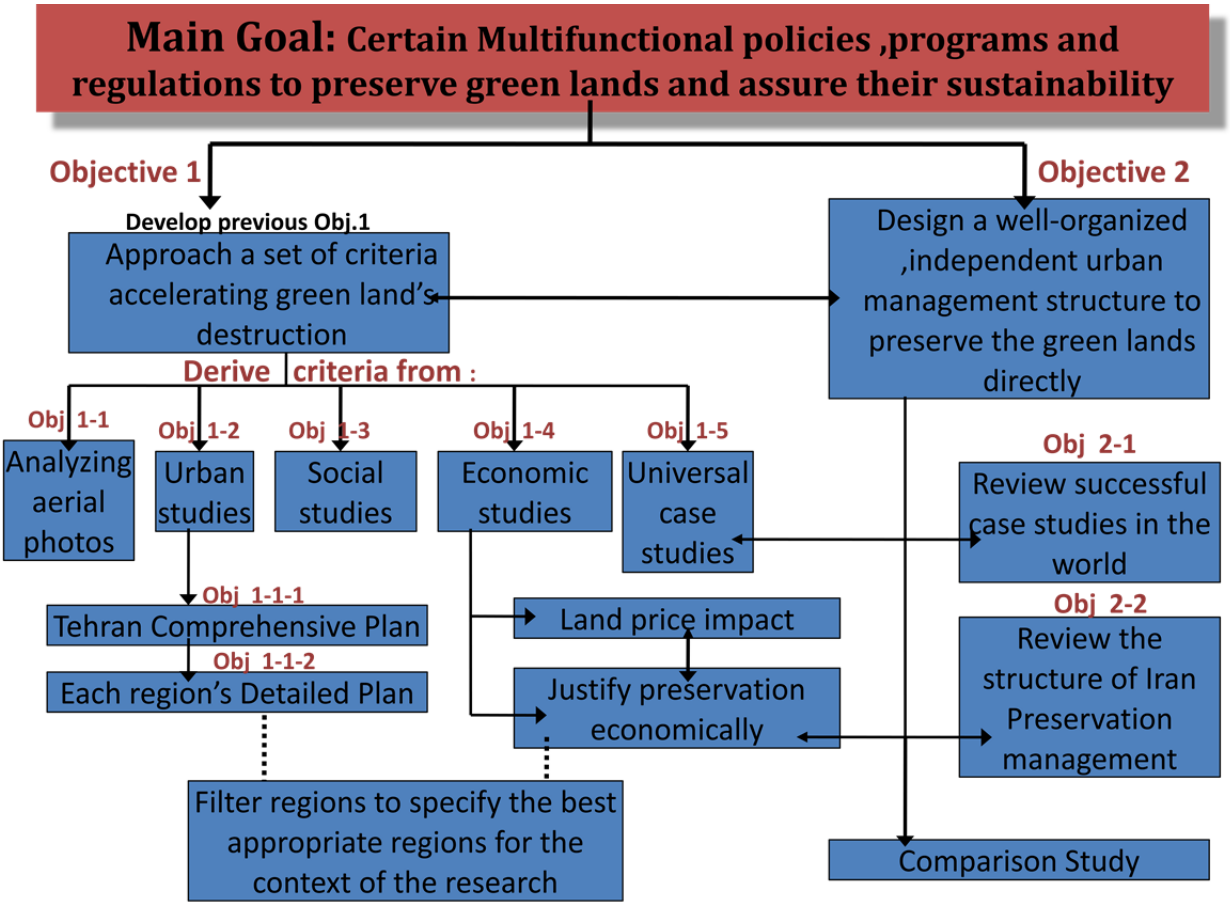
The first objectives designed for the research were to approach a set of characteristics, causes and factors which accelerate green lands disappearing. By achieving the very first objective, the second one which is to explore the solutions for gardens and agricultural lands sustainability could easier be followed. Finally by completing the first two objectives the research can approach a set of rules, policies, programs and regulations to preserve green lands which is the content of the last research objective.

During the research process, the main goal was designed by combining the second and the third objective as shown in figure 1.2: "to develop certain multifunctional policies, programs and regulations according to different characteristics of the regions to preserve green lands including urban gardens and agricultural lands".

Taking this main goal into consideration, previous two objectives developed and couple of sub-objectives could be defined for the current research. The first previous objective altered to approach a set of criteria accelerating green land destruction. To achieve this objective there should be a broad and deep study in different fields and in order to derive the criteria which could be the cause of green lands destruction in cities. Therefore the sub-objectives would be to derive criteria from aerial photo analysis to perceive which reasons have had influence on the sustainability of gardens during the time. Studying Tehran Master Plan and Tehran Regions Detailed Plans as the only available and related urban plans would end up in different urban criteria. Furthermore, social criteria can be extracted from social studies to understand the impact of different social levels and cultural backgrounds of Tehran residents on destroying/preserving green fields. Another sub-objective would be to derive criteria from economic studies by finding the impact of land price and land speculation on green fields preservation. Moreover analyzing universal case studies prepares the ground to find out the advantages and disadvantages of these experiences and the consequences of their tasks, projects or approaches and come to new sets of criteria in the field of management and legal structure.

Meanwhile, the second objective has been developed as: Design a well-organized, independent urban management structure to preserve the green lands directly. In order to achieve this second objective, two sub-objectives have been defined. Successful case studies from other parts of the world have to be reviewed and likewise the structure of the Iran preservation management. Comparison study between the mentioned sub-objectives would lead the author to extract the criteria which are crucial in the preservation success elsewhere and which are missing in the Iran urban structure.

Figure 1.2: Research goal, objectives and sub-objectives



Source: The author

1.4 Research hypotheses

In the beginning of the research three hypotheses have been stated. There may be some criteria which have direct impact on green land destruction/sustainability which should be examined by using Geographic Information System tools as parcel size, land use, ownership, the distance to the urban rivers or mountains or qanats[1] and finally the distance to urban roads (accessibility). GIS would be applied as a tool to examine the hypothesis clarified as follows.

Regarding the impact of the parcel sizes, the hypothesis is stated that the bigger the garden parcel is, the harder is to destroy it. Small parcels are easier to capture and to negotiate. The sustainability of a garden is also related to its second land use which means the second activity in addition to green land cover in the certain parcel. These activities can be positive for garden preservation such as restaurant and exhibition or destructive, such as warehouse and parking. At the same time ownership has a crucial role in preserving the green fields. Private-owner gardens are more threatened because there are more individual economic intentions and motivations which could be realized easier by one person's decision in private ownerships. Moreover, the longer the distance between the gardens and the rivers, mountains, or Qanats, the smaller the parcels are and as a consequence the

[1] The qanat technology is known to have been developed by the Persian people sometime in the early 1st millennium BC and to have spread from there slowly west- and eastward. It is one of a series of well-like vertical shafts, connected by gently sloping tunnels. They create a reliable supply of water for human settlements and irrigation in hot, arid and semi-arid climates. Much of the population of Iran and other arid countries in Asia and North Africa historically depended upon the water from qanats; the areas of population corresponded closely to the areas where qanats are possible. Although a qanat was expensive to construct, its long-term value to the community and thereby to the group that invested in building and maintained it, was substantial.

shorter the sustainability they have. This distance relationship is also another hypothesis which would be tested during the research process. The hypothesis regarding the accessibility can be explained as, the better accessibility a garden has, the more likely is the possibility to destroy it.

The above criteria were the content of the first hypothesis which would be accomplished by using GIS tools. Besides, the second hypothesis states that preservation incentives cannot be without economic benefit. Thereby it is tried to prepare an economic ground for the whole research. Emphasizing the economic aspects of preservation transforms the research content from pure ecological one to more practical and actual ones.

The third hypothesis affirms that garden or farmland preservation should not be exacted by the authority of a municipality. This statement requires a profound study to demonstrate why the current structure in the Iran preservation body should alter to a form in which municipality has less responsibility concerning preservation.

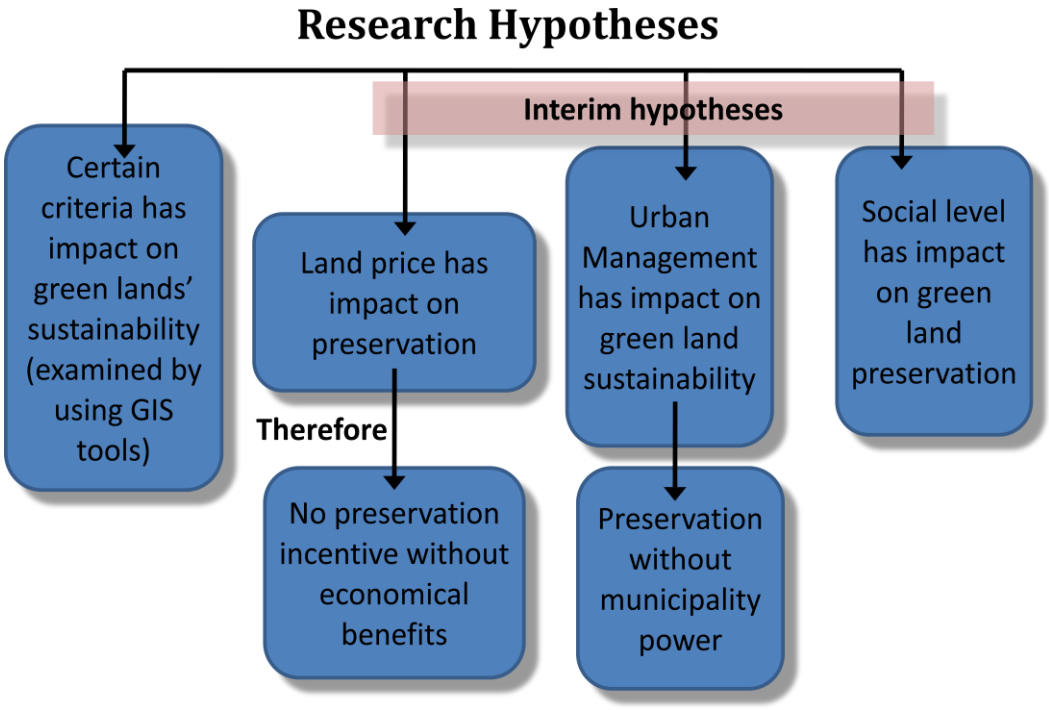
As research went on, three interim hypotheses have been developed from which two attempted to complete the content of the very first hypotheses:

Regarding the second hypothesis, still the missing element of land price has been added. Preserving green lands gets the chance of development and economical benefits from the owner. Therefore land price is the connecting link between preservation and benefits. Consequently, this hypothesis can be restructured as: Land price (land speculation) has impact on preservation, thus preservation incentives cannot be without economical benefits.

In the third hypothesis municipality should be considered as an element of a broader structure of the urban management. As urban management has impact on green land sustainability, any preservation has to take place outside the power of the municipality.

The last interim hypothesis tries to give more multidimensional character to the research and highlights different aspects of study conducted to preserve gardens and farmlands. It states that the different social levels of Tehran residents have impact on green land preservation. Cultural, educational, economic status of different social levels could clarify this correlation and might explain the impact. Figure 1.3 gives an overview on the process explained above.

Figure 1.3: Research hypotheses and the development of interim hypotheses



Source: Author

1.5 Research process

The current research has 7 phases and 6 chapters (Figure 1.4). In the first phase which is the research review, the main elements of the research will be mentioned as well as the goals and objectives, the research hypotheses and the key issues from which the research questions are obtained. To clarify the main problem and the necessity of the research the current situation of climate change in Iran and Tehran based on time and region will be studied. In this step air pollution data, the decrease history of green lands and their consequences will be presented to indicate how acute the problem is. After this introduction the research steps into the second phase, i.e. the theoretical basis.

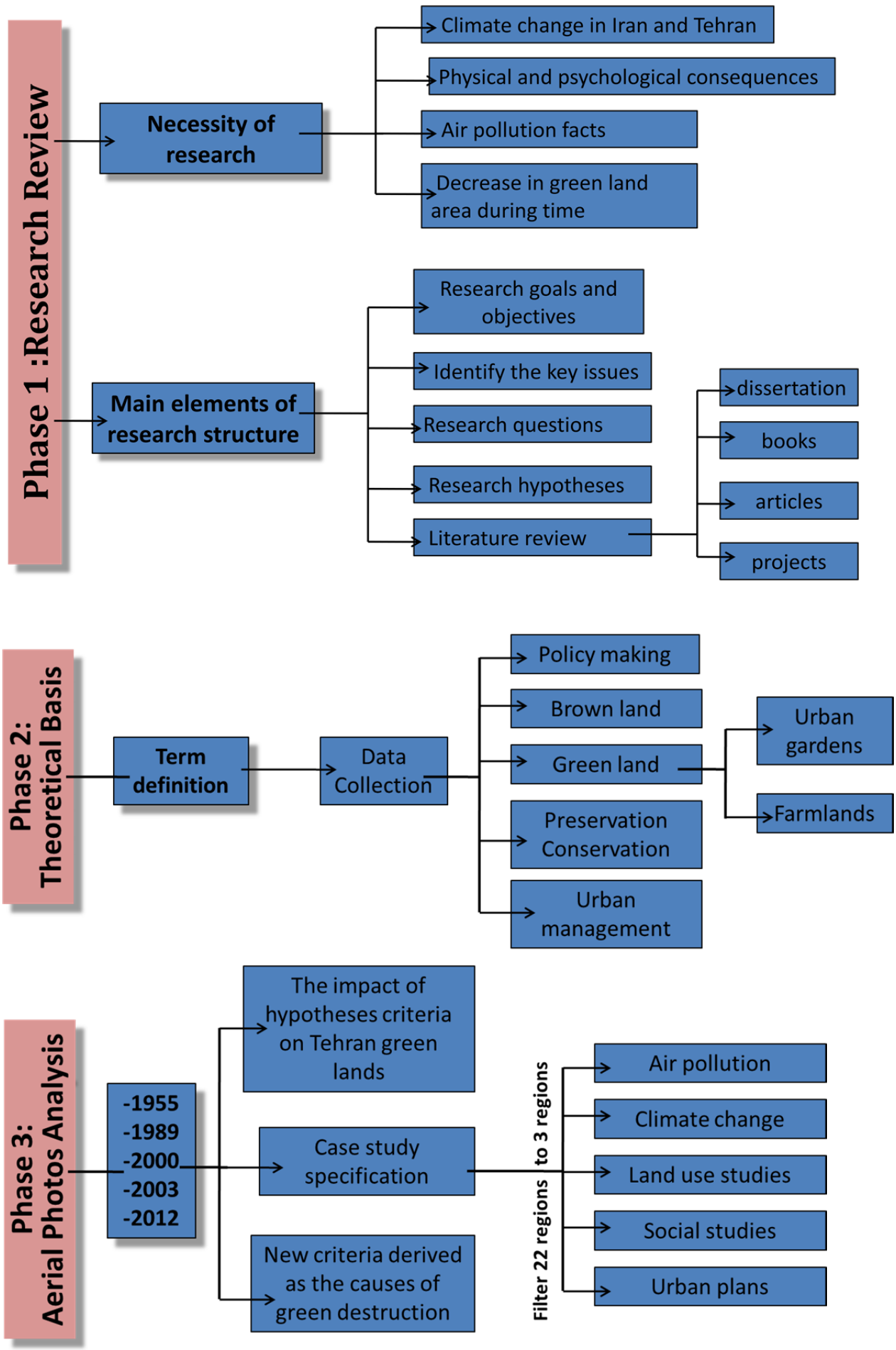
In the second phase the terms used in the research process will be identified and some will be redefined as a specific term for the current research. The meaning of garden and farmland ought to be clear to let the researcher choose the right parcels according to one clear definition, therefore legal definitions will be extracted and combined with urban, ecological and common ones.

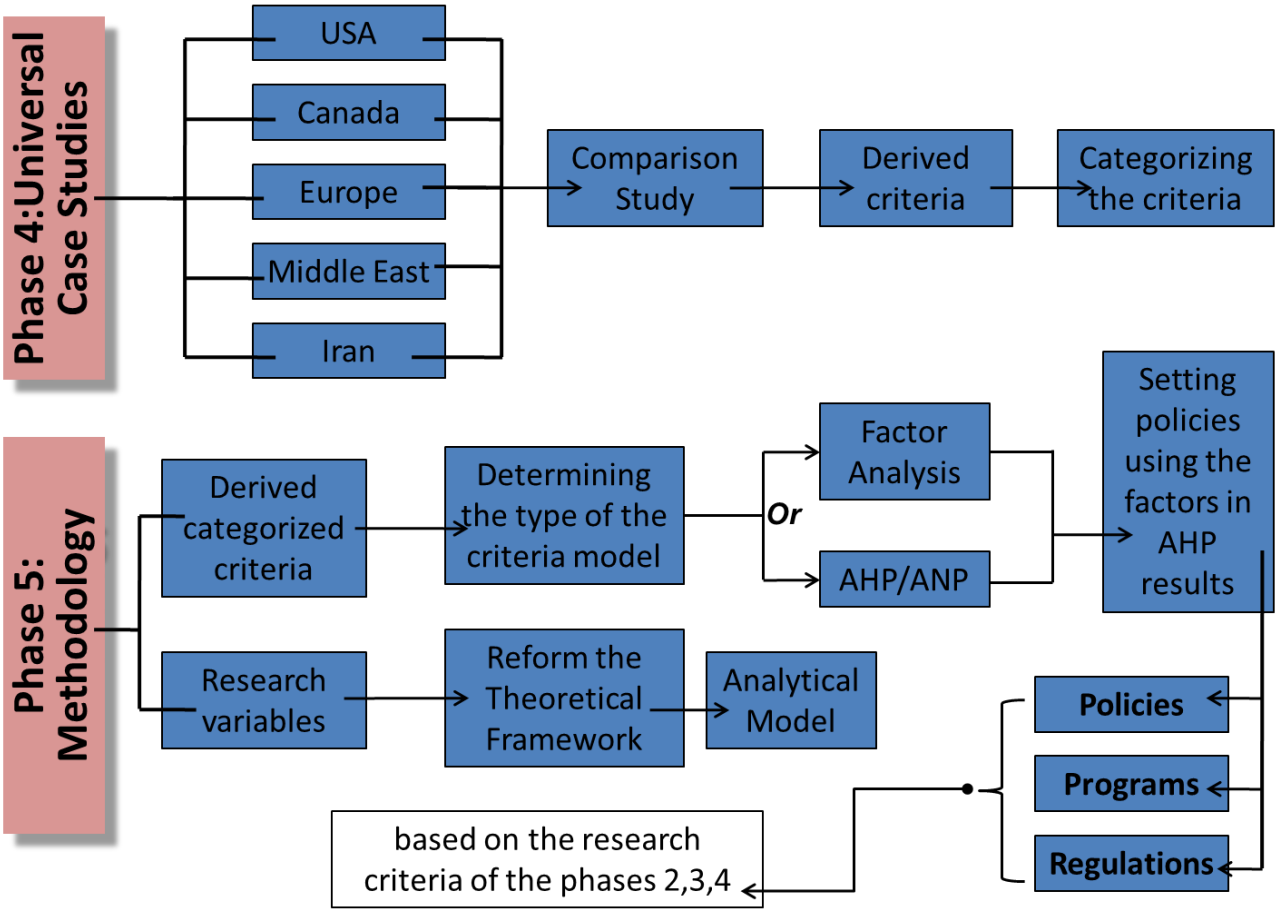
Based on the exact definition of garden and farmland, aerial photos of Tehran from 1955 to 2012 will be analyzed which will conclude with three different outcomes: The first research hypothesis (explained in 1.4) might be examined by this analysis and the impact of the criteria mentioned during the time could be studied. In addition new criteria could be found as the main reasons of green destruction in Tehran over time. At the same time this study is used to determine which regions out of 22 regions in Tehran have the most priority to be preserved. The destruction speed, sort, ownership, second land use, climate change characteristics, social status and importance of the destroyed/ remaining gardens could be compared with each other during the time and the case study regions will be selected for the whole research.

The fourth phase attempts to gather successful and unsuccessful preservation examples from the world and compare their approaches, characteristics, plans, programs, rules, management structures and outcomes with each other to build an optimal framework for green fields preservation. The second step of this phase is to study the preservation structure of Iran and to compare it with the created framework and thus to try to alter Tehran current framework to the optimal form by taking the local characteristics of Tehran into consideration.

At the last phase all the variables derived in the previous phases will be inserted into a theoretical framework and by reforming this framework the analytical model will be generated. Simultaneously, the most crucial step of the research will be conducted in this phase by extracting different criteria from different chapters of the research, and categorizing them according to context or function. When all the criteria will have been gathered and the criteria model will have been generated, the type of method will be chosen, there are in general two methods suitable for this kind of research, SPSS or Analytic Hierarchy Process (AHP). The type of data and its availability have to be specified first, and in chapter 6 based on all the criteria of the different phases, the method will be clarified exactly. If the collected data are objective, Factor Analysis (F.A) by using SPSS tools can be mostly suitable. Nevertheless, there is one kind of F.A called Confirmatory F.A which can enter subjective data and by considering the types of data C.F.A might be applicable. If the method is F.A, the criteria will be transformed into factors in SPSS. By using the results of a factor analysis in SPSS tools the correlation between different factors will be determined and the policies, programs and plans for each region will be set according to this outcome. If the type of criteria model is not deductive or inductive but hierarchical, AHP might be a better choice as the research method. However, choosing AHP depends on the type of data and criteria (subjective or objective). If AHP or Analytic Network Process (ANP) is used, the hierarchy of the policies, programs and plans in each region will be determined according to the importance of criteria from different chapters.

Figure 1.4: Research phases and the main contents of the research





Source: The author

1.6 Research methodology

At the first stage, aerial photos analysis will be conducted by geo-referencing the aerial photos of Tehran from 1955, 1989, 2000 and 2012. The amount of green lands destruction during this period of time will be calculated for both urban gardens and agricultural lands. It will be attempted to find the causes and reasons of green land loss in different decades and to find out the possible relationship between different urban elements or natural resources and the destruction process. The results of this analysis will be presented in the form of criteria to be used in the factor analysis.

In the second step, the correlation between the criteria mentioned in the hypotheses will be examined by using GIS tools to ascertain if there is any correlation between green sustainability/destruction and the parcel sizes, the distance to rivers, the distance to mountains, ownership and green preservation, second land use and the access to road network. The results of the second step will be transformed into criteria to be used in the final factor analysis.

The third step is to go deeply through urban plans and conduct urban studies to find out the urban legal reasons in the current plans which end up to green land destruction. For this phase the urban planning documents of Tehran and of each case study regions will be studied. Tehran Master Plan 2006 and the Detailed Plans of regions 1, 2 and 18 are the only urban documents essential and available for this part.

Discussing the economic data would be considered as the next step. Land price, land speculation and how the economic aspects of green lands destruction can be clarified during the time is the question of this analysis.

Social studies are the main part of the fifth step. Different social levels of society and their impact on destroying the green especially the private green will be studied. It will be tried to categorize people for whom the author is planning and different cultural aspects of the case study regions will be naturally.

Working on case studies is the content of the sixth step which compares Iran preservation plans with successful preservation plans elsewhere to find out the possible changes in different dimensions of city planning which could be altered to increase the feasibility of preservation and to explore the positive impact.

The seventh step is to study Iran urban management structure related to green lands preservation and conduct a comparison study between Iran management/law and successful examples elsewhere in the world. There could be regulations which cause destruction by their unclear boundaries and incorrectly defined contents.

Gathering climate change data and analyzing air pollution indexes are the eighth step.

From each step mentioned above, related variables clarifying green destruction/sustainability will be derived. These variables will be either composited, combined and then transformed into factors to be used in the factor analysis or will enter AHP and their hierarchy and their importance to achieve the whole research goal will be determined. The choice between F.A and AHP depends on the type of criteria model and the criteria themselves. Nevertheless, in both methods the importance/correlation of each criterion to the others will be calculated and the variables with the most impact on the whole preservation procedure will be extracted.

At the end, the factors with more impact on green lands will be used for the final policies, completing programs or regulations for that region. The alternatives of policy making will be presented by using the factors extracted from factor analysis/AHP and the hierarchy of the policies will be determined by AHP/ANP[1] tools according to the research objectives.

[1] Analytic Hierarchy Process/Analytic Network Process

2 Theoretical Basis and Definition of Terms

In this chapter the literature review and the state of the art will be reviewed. In each part different definitions, descriptions, interpretations and explanations for the terms used in the research will be given and the most suitable definition for the dissertation and its various aspects will be explored. The goal is to give a short history about the keywords and main discussions in the whole dissertation and as a result explain how this study will add knowledge to the related science world. In addition, the theoretical basis on which the rest chapters are dependent will be formed. This will be the base for all the discussions to the end of the research and will remain the research framework.

In this part the brief definitions of the terms used in the research title and content will be discussed and when there are contrary explanations, the most appropriate one will be selected for the study. The second objective is to introduce the main fundamental scientific theory of the research.

2.1 Sustainable development

The importance of sustainable development is so high that Koichiro Matsuura, the UNESCO director-General states: “We have no longer a choice: either we adopt behaviors that respect sustainable development, that is we stop polluting the environment, allow for the renewal of natural resources and contribute to the improvement of the well-being of all, or sooner or later we sign our own death warrant. The ultimate goal of the Decade is that sustainable development must be more than just a slogan. It must be a concrete reality for all of us – individuals, organizations governments – in all of our daily decisions and actions, so as to promise a sustainable planet and a safer world, to our children, our grandchildren and their descendants (UNESCO, 2005, p.1).”

“In 1968, UNESCO organized the first intergovernmental conference aiming to reconcile environment and development, what we now call “sustainable development”. It led to the creation of UNESCO’s Man and the Biosphere (MAB) Programme. The conference was a significant step in the process that in 1972 resulted in the Conference on the Human Environment, held in Stockholm – the first United Nations conference on the environment (UNESCO, 2005, p.2).” “One of the earliest formulations of the concept of the sustainable development can be found in 1980’s World Conservation Strategy jointly presented by the United Nations Environment Programme (UNEP), the World Wildlife Fund and the International Union for Conservation of Nature and Natural Resources. It called for three priorities to be built into development policies: the maintenance of ecological processes; the sustainable use of resources; and the maintenance of genetic diversity (UNEP/WWF/IUCNNR, 1980 quoted after Azapagic et al, 2004, p.4).” “In 1987, the World Commission on Environment and Development (WCED), presided by Gro Harlem Brundtland, used the expression “sustainable development” for the first time in its report, “Our Common Future”. The concept has evolved constantly ever since (UNESCO, 2005, p.2).” In order to reserve unsustainable trends, the WCED recommends the seven critical objectives for environment and development policies that follow the concept of sustainable development: revive growth; change the quality of growth; meet essential needs and aspirations for jobs, food, energy, water and sanitation; ensure a sustainable level of population; conserve and enhance the resource base; reorient technology and manage risk; and include and combine environment and economic considerations in decision-making (WCED, 1987).

On November 18, 1992, some of the World's senior scientists from 70 countries, including 102 Nobel Laureates, signed and sent an urgent warning to government leaders of all nations as part of the United Nations Conference on Environment and Development (the "Earth Summit") held in Rio de Janeiro, Brazil. According to this warning:

"The environment is suffering critical stress.... Our massive tampering with the world's interdependent web of life - coupled with the environmental damage which is inflicted by deforestation, species loss, and climate change - could trigger widespread adverse effects, including unpredictable collapses of critical biological systems whose interactions and dynamics we only imperfectly understand. Whether industrialized or not, we all have one lifeboat. No nation can escape injury when global biological systems are damaged. No nations can escape from conflicts

over increasingly scarce resources. In addition, environmental and economic instabilities will cause mass migrations with incalculable consequences for developed and underdeveloped nations alike.... (UNESCO EOLSS, 2014)."

The assembled leader in Rio de Janeiro in 1992 also signed the Framework Convention on Climate Change, the Convention on Biological Diversity, and the Forest Principles (Azapagic et al., 2004, p.5)."

"The main points of the sustainable development concept are defined by Agenda 21, the Action Programme for the 21st century adopted by governments at the Rio Earth Summit in 1992. At the institutional level, Rio represents a crucial turning point, opening a new era of cooperation between governments, NGOs and the private sector. UNESCO received the responsibility for implementing the Agenda's Chapter 35 (Science for sustainable development) and Chapter 36 (Promoting education, public awareness and training). The latter states: "Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues." UNESCO provides support to Member States and develops pedagogical material for sustainable development education (UNESCO, 2005, p.3)."

It will be useful to recall Agenda 21 of the Earth Summit. The first part of Section 5.3 of the document says:

"The growth of world population and production combined with unsustainable consumption patterns places increasingly severe stress on the `life supporting' capacities of our planet. These interactive processes affect the use of land, water, air, energy, and other resources (UNESCO EOLSS, 2014)."

"The Rio summit was followed by several other events which include: the Global Conference on Sustainable Development of Small Island Developing States, Barbados, 1994; the International Conference on Population and Development, Cairo, 1994; the World Summit on Social Development, Copenhagen, 1995; the Fourth World Conference on Women, Beijing, 1995; the Second UN Conference on Human Settlements, Habitat II, Istanbul, 1996; and other non-UN forums. All these, and many other events, have raised awareness and contributed to the concept of sustainable development (UNESCO EOLSS, 2014)."

"At the Johannesburg World Summit on Sustainable Development in 2002, not only did the number of NGOs and private sector actors among the participants increase, but their commitment to sustainable development deepened at all levels, from local to global. The Summit affirmed its collective determination to promote the pillars of sustainable development – economic development, social development and safeguarding the environment – as interdependent and mutually reinforcing. A part of Goal 7 of MDGs is to ensure environmental sustainability as follows: Integrate the principles of sustainable development into country policies and reverse present trend of loss of natural resources (UNESCO, 2005, p.3)."

The meaning of sustainable development and its domain has developed during the time. It started from the absolute environmental concept and developed itself to different socio-economic and cultural contents. The later this approach is implicated, the more multidimensional it is. The creativity has been more and more significant in using this term and creativity means not having just one limited view to sustainability. "At first emphasizing environment only in development policies, the idea has encompassed socioeconomic domains since the Johannesburg Summit (2002). It now incorporates other areas previously neglected by development, such as education or culture, the latter being recognized as a full-fledged source of development by the Universal Declaration of Cultural Diversity adopted by UNESCO in 2001 (UNESCO EOLSS, 2014)."

In Our Common Future, Report of the World Commission on Environment and Development in 1987 the most famous definition of sustainable development is given:

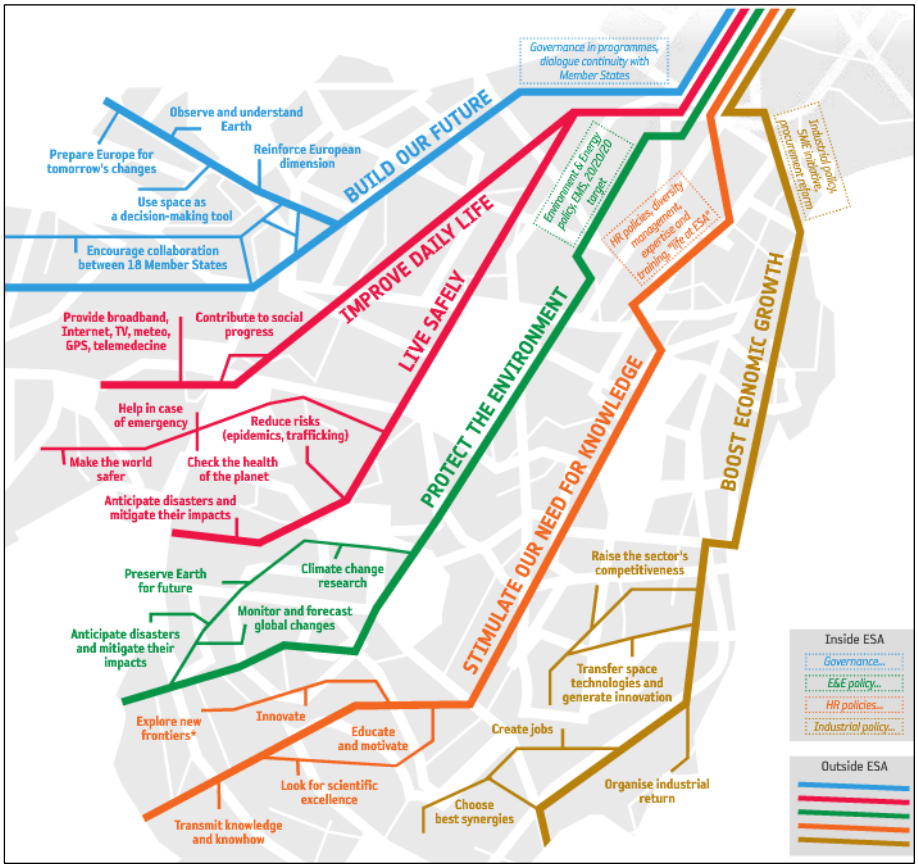
"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. A vision of development that encompasses populations, animal and plant species, ecosystems, natural resources water, air, energy and that integrates concerns such as the fight against poverty, gender equality, human rights, education for all, health, human security, intercultural dialogue, etc."

In its sustainable development strategy the UK government defines sustainable development as “the simple idea of ensuring a better quality of life for everyone, now and for the generations to come (Deter, 1999 quoted after Azapagic, 2004, p.6).”

One of the most prominent and influential definitions of sustainable development comes from a “Strategy for Sustainable Living” (UNEP/WWF/IUCN, 1991), a joint publication by the UNEP, International Union for the Conservation of the Nature (IUCN) and WWF, in which sustainable development is defined as “improving the quality of life while living within the carrying capacity of supporting ecosystems”. In a similar vein, in its “Action for Global Sustainability”, the Union of Concerned Scientists advocates that “humanity must learn to live within the limits of natural systems while ensuring an adequate living standard for all people (UCS, 2001 quoted after Azapagic et al., 2004, p.7). “

On the basis of the official definition of sustainable development, European Space agency (ESA) links sustainable development values to ESA key issues and challenges presented in figure 2.1. This figure is an illustration of all the terms and concepts which are significant in defining sustainable development. It points out the aspects and dimensions of sustainable development while describing each element of it and can be considered as one of the most comprehensive illustrated definition.

Figure 2.1: Illustrated definition of sustainable development by ESA



Source: Walker, 2011, p.6

To sum up, the best definition which is a combination of the above points of views and is formulated for this study can be a development which builds our current quality of life and cares about the future environment, economy, society, culture, management, regulations, instruments and knowledge. The world is an ongoing phenomenon and human being and his activities in urban life should not build up a barrier to this natural procedure. When all these aspects are taken into consideration and a strong connection is made between all these dimensions at the same time, the development can successfully be sustainable.

2.1.1 Dimensions of sustainable development

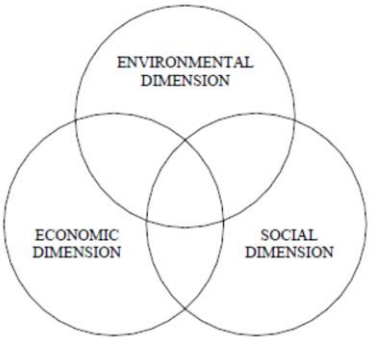
The Future We Want, the outcome document of the UN Conference on Sustainable Development (Rio+20), proposes a comprehensive path towards a sustainable development comprising three interrelated dimensions: environmental, economic and social. The Decent Work Agenda (DWA) is a key element of sustainable societies. Participants at Rio+20 emphasized key elements of the DWA. Poverty eradication, full and productive employment, decent work, and social protection are interrelated and mutually reinforcing. Governments are urged to implement strategies and policies to address the challenges of youth unemployment. Investments are urgently needed to develop economic and social infrastructures along with productive capacities. The entire UN system should contribute to this effort, especially in developing and least developed countries. National efforts should also provide men and women living in poverty in rural and urban areas with new job opportunities, including those in small and medium sized enterprises (ILO Newsletter, 2012, p.1). UNESCO and Sustainable Development, 2005 considers the figure 2.2 as the explanations of the sustainable development dimensions and the sub-subjects which have to be taken into account.

Figure 2.2: The dimensions of sustainable development by UNESCO

Source: UNESCO and Sustainable Development, 2005

Giacomo D' Alisa (2007) reviews the different theories and dimensions concerning sustainable development and tries to go through the dimensions step by step to add a new dimension to that mentioned above. He believes that "the discussion about sustainable development has dealt with strictly environmental topics forgetting that the word environment conveys a concept that has a human dimension too. From the cultural point of view it has been neglected that the sustainability, as a strategic choice, is an alternative to increase and that social problems are the elements of a possible approach to the sustainable development, and are not separated from it." As shown in Figure 2.3, this approach has contributed to the visualization of the sustainable development as the intersections among economic, social and environmental system.

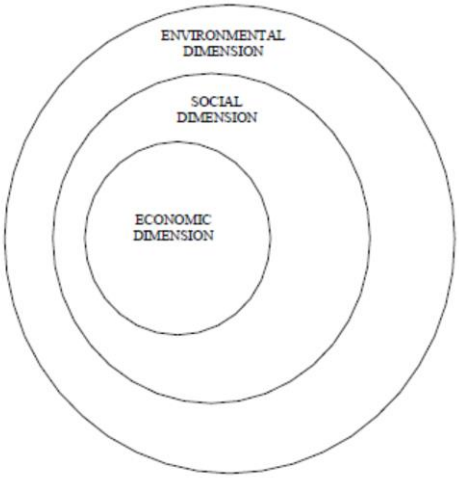
Figure 2.3: Three first defined dimensions of sustainable development



Source: D'Alisa, 2007, p.11

This visualization implies that some parts of the economic system are independent of the social system, as if it were possible to imagine economic relations that do not need the social substrate; similarly as to the social system, it is represented as if the existence of a social structure could exist without a natural system which supplies natural resources. To overcome this restricted vision, D'Alisa, proposes a concentric representation of the sustainability dimensions. To give, in fact, a better representation sustainable development should have to be shown as a set of concentric dimensions (Figure 2.4).

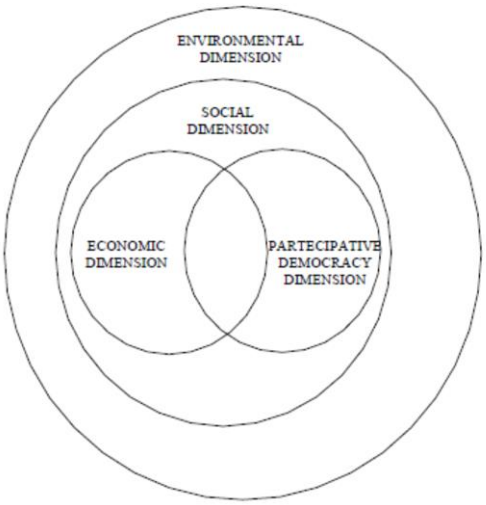
Figure 2.4: Modified visualization of the dimensions of sustainable development by D'Alisa



Source: D'Alisa, 2007, p.12

"This view should show a physically-embedded economy and that as J. Martinez-Alier in 2006 states *a natural environment without a human economy existed for a long time but there cannot be a human economy without an environment*. To have an exhaustive vision for an effective strategy of sustainable development to these three dimensions, D'Alisa adds a fourth institutional one which is participative democracy, shown in figure 2.5. It will be contained by the social dimension and it is intersected with the economic dimension since some decisions. As an active participation of people to the strategies planning deal with economy, for some productive and consume choice, and with public institution non-directly linked to the economic system but concerning policy issues (D'Alisa, 2007, p.11-12)."

Figure 2.5: The fourth dimension added to sustainable development by D'Alisa



Source: D'Alisa, 2007, p.12

A major premise motivating the evolution of the Encyclopedia is that economic and other development policies should be based on the principles of sustainability, namely: intergenerational equity, intra-generational equity, precautionary principle (risk aversion strategies) and conservation of biodiversity.

In this respect, several knowledge resources are essential for an integrated and comprehensive understanding of the sustainable development paradigm. Naturally, scholars from diverse fields of specialization tend to use different nomenclature to characterize this knowledge. However, the following broad framework has received wide acceptance:

Natural Resources or Natural Capital (The Environmental Dimension)
Economic Resources or Built Capital (The Economic Dimension)
Social Resources or Social Capital (The Social Dimension)
Institutional Resources or Institutional Capital (The Institutional Dimension)

The complex interactions among the various subsystems are shown in Figures 2.6 and 2.7. Figure 2.6 shows the various fundamental dimensions of the sustainable development paradigm, which relies on a wide spectrum of disciplines. Figure 2.7 suggests what has to be sustained by human policies aimed at a better quality of life.

Other ways of subdividing the total system are possible. In order to keep the total system viable (the human system embedded in the natural system), each of these essential subsystems must be viable. Viability of the total system depends on the proper functioning of the sub-systems. The six subsystems correspond to potentials that must be sustainably maintained. Although other classifications are possible, this identification of subsystems is not arbitrary.

The knowledge needed to understand the sustainability of the subsystems is highly interdisciplinary. For instance, to understand the sustainability of the Natural Capital (or Environmental Dimension), one has to rely on disciplines such as Biology, Physics, Chemistry, Geology, as well as Mathematical Sciences in addition to the use of technological tools such as Computer Systems, Remote Sensing, Global Information Systems, etc. as depicted for the sake of simplicity in Figure 2.8 (UNESCO EOLSS, 2014).

Figure 2.7: The complex interactions among the different dimensions of sustainable

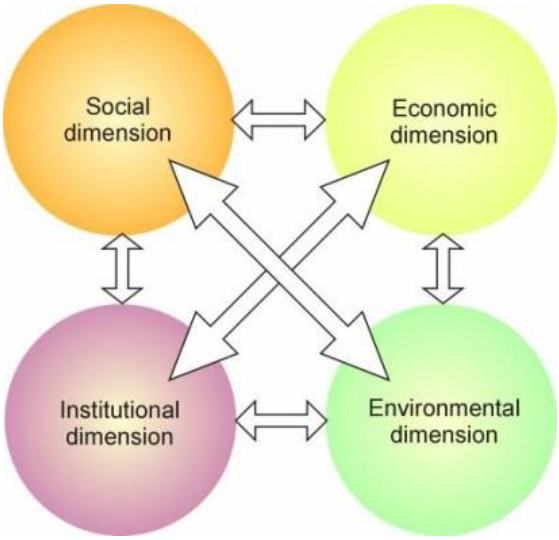
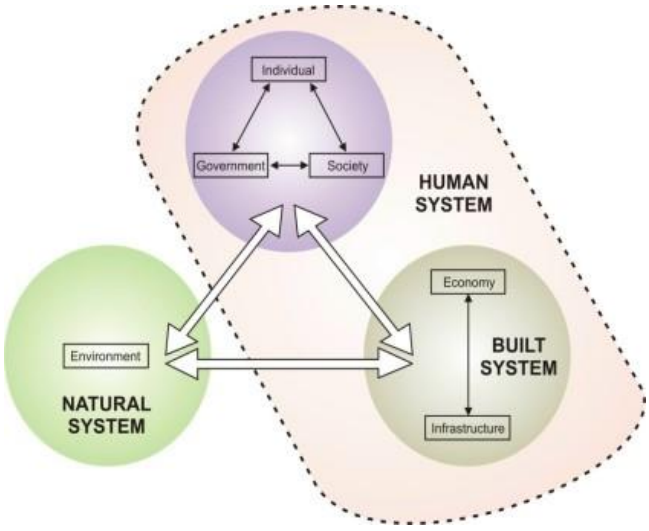
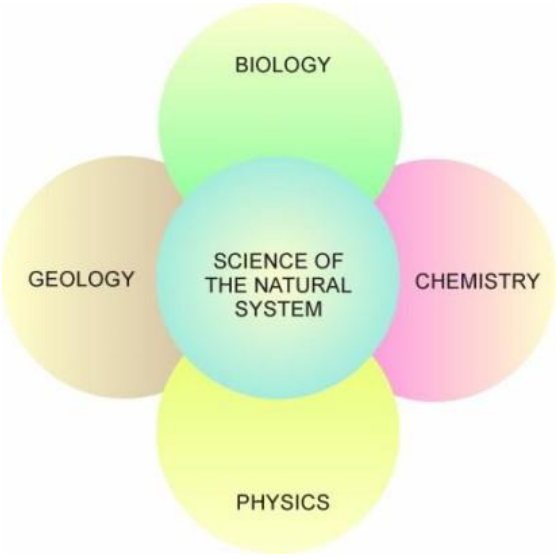


Figure 2.6: The six major systems of the anthroposphere and their major relationships. These six sector systems can be aggregated to the three subsystems: Human System, Built System (Human Engineered System) and Natural System.



Source: UNESCO EOLSS, 2014

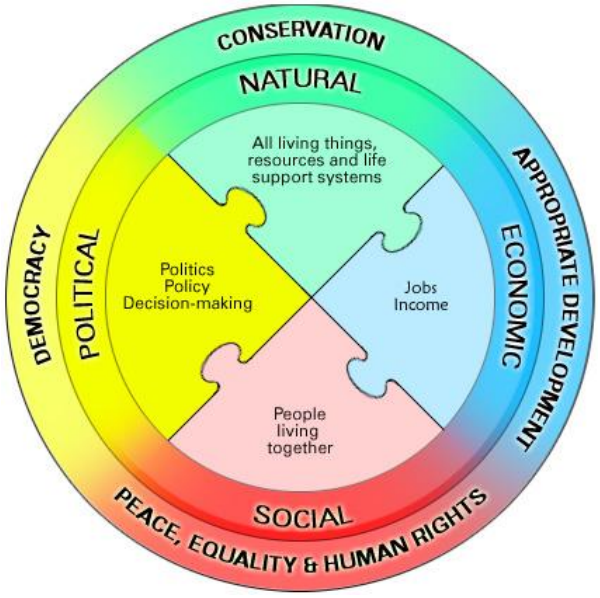
Figure 2.8: An understanding of the sustainability of the natural system lies at the confluence of many disciplines



Source: UNESCO EOLSS, 2014

Finally, it presents four main dimensions for sustainable development in "UNESCO teaching and learning for sustainable future 2012" as shown in figure 2.9. In this figure the dimensions instead of institutional dimension stated in previous models, political has been substituted. However, in context the meaning and function of this dimension is very similar to institutional one.

Figure 2.9: Four dimensions of sustainable development by UNESCO



Source: UNESCO teaching and learning for sustainable future 2012

In this research similar to what D'Alice stated, it is attempted to overcome the restricted vision of sustainable development which only emphasizes environmental aspects or at the best scenario adds socioeconomic dimension to it. However, institutional/ political aspects as a fourth dimension is defined as the management structure, legal system and juridical aspects which supports sustainability and is combined with the previous ones

(which is not exactly what D'Alisa and UNESCO added to sustainable development dimensions). A society with people participation and enough economic and social capital cannot be managed without organized regulations which lead the whole development and management structure to the sustainable urban development. Therefore, this study highlights the importance of the new fourth dimension of sustainable development which prepares the legal ground for all 3 other ones and is the guarantee of a correct implementation of sustainability.

The outstanding characteristic of the research is how it combines sustainable development dimensions, in other words multi-dimensionality shown in figure 2.5 and interdisciplinary as explained in figure 2.8. As mentioned in UNESCO EOLSS, all sub-systems should function sustainably to guarantee the sustainability of the entire system. Consequently, each dimension plays an important role and has to be studied separately and thoroughly whereas, simultaneously, a strong conjunction between all the dimensions has to be kept. It is attempted to achieve a balance between the human system, the built system and the natural system, as shown in figure 2.6. The detailed explanations of the dimensions and the criteria attached to them are given in chapter 6, as a result of the literature review the following dimensions have been defined and selected for sustainable development in this study:

1. The *Institutional-juridical dimension* of sustainable development which embed the characteristics of the management structure and related laws, regulations and jurisdictions.
2. The *socio-cultural dimension* of sustainable development: as many social and cultural factors in Iranian society are closely interrelated to each other, this research has tried to compile them all in one category to keep their impacts on each other in one group and better to highlight their connections. Even if in the reviewed models from UNESCO, D'Alisa and others, the cultural dimension has been implicit and more mentioned within social factors, in this study cultural aspects have so an outstanding character that they have to be clearly remarked in the main categories in the research structure.
3. The *Economic-financial dimension* of sustainable development: In all the reviewed dimensions the economic element has been mentioned but in the case of Iran, the economic problems and financial problems of the municipality and the entire urban management system have a big influence on the green lands' preservation. Consequently, this dimension should not be ignored and can be combined with the economic one.
4. The *Eco-urban dimension* of sustainable development: Natural or environmental dimension has been the basic and the strongest aspect of sustainable development from the very beginning. As this research attends to have a broader, multi-dimensional point of view to the subject "Ecology" will substitute the mentioned dimension. On the other hand, the research context is an urban issue and there will be several urban criteria derived from different chapters which have a close linkage to ecological subjects. As a result there are ecological problems occurring in urban atmospheres which lead to urban issues for the city residents. Thus, this dimension is called "Eco- urban" in this study.

The four above dimensions of sustainable development are a combination of the literature review, the debates which will be discussed in the current state of Iran urbanism and the green lands' preservation (according to chapter 4 and 5 results). They have been created for this study and will remain the main research structure to the last chapter. The criteria which have impact on green lands' destruction/sustainability will be built on the theoretical base and the dimensions of sustainable development explained here so that this theory has its footprints in each part of the research and operates as a thread sewing different topics with each other. It gives balance and compatibility to the study and is always in the background. Taking all these dimensions simultaneously into account prevents the restricted view that D'Alisa criticized in Figure 2.3 and strengthens the multi-dimensional approach which has been followed from the beginning.

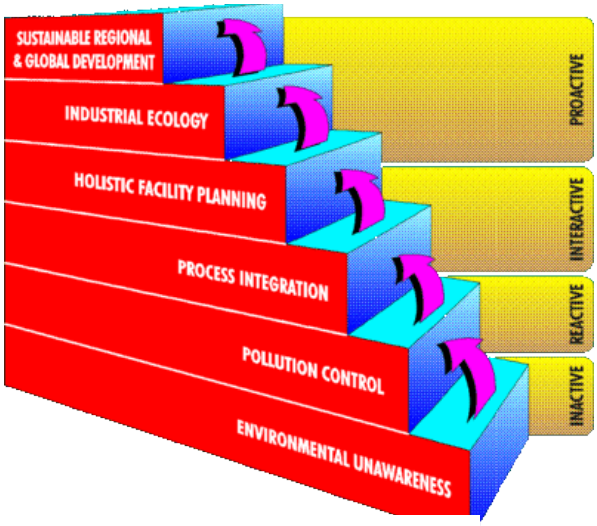
Figure 2.10 is regarded as a maturity model for sustainable development with four time-scales. The far past is associated with inactive approaches in which there is no concern for environmental degradation and sustainability.

"-The time-scale of the immediate past is concerned primarily with reactive approaches. It involves prevention oriented remedies and strategies for coping with improper disposal of industrial wastes and environmental degradation due to the acquisition of environmentally inappropriate products and practices.

-The time-scale of the present is associated with interactive approaches and is concerned with regulations and standards that ameliorate the harmful effects of those processes which might otherwise result in the creation of harmful products and services.

-The time-scale of the future is concerned with proactive approaches that prevent the degradation of the earth, respect its carrying capacity and assure sustainability of essential resources, processes, and products by means of engineering, and re-engineering, of production processes and of organizations. A proactive approach to sustainable development would also include interactive and reactive components. Tragedies and crises will occur, despite the efforts to prevent them, and reactive techniques may often be the only way to diagnose and remedy such situations. To achieve these aims requires a broad understanding of many scientific disciplines and technologies, and their interactions leading to an integrated knowledge base for the sustainability of the world resources in their broadest sense (UNESCO EOLSS, 2014)."

Figure 2.10: Towards Sustainable Development - A Maturity Model



Source: UNESCO EOLSS. 2014

Based on the information given about climate change in Tehran in chapter 3, it can be claimed that Iran and especially Tehran is still somewhere between the first-inactive- and the second- reactive- phase. It is now well perceived by the policy makers that new environmental decisions in the form of strategies and regulations should be made to cope with the current status. For this reason, the study of green lands' conservation in Iran has become increasingly important in Tehran urbanism in the recent years.

2.1.2 Major methodological approaches to sustainable development

Figure 2.11 shows how different economic theories deal with sustainability. "The authors reach such schematic visualization, analyzing different approaches by means of economics characteristics, strategies and finally sustainability criterion associated to the several economic theories; D'Alisa keeps these categories as well as the distinctions between techno-centric and eco-centric approaches.

Analyzing several approaches, we can find that the supporters of *techno-centrism* believe in the perfect substitutability between natural and artificial capitals, they think that individuals and technology can overcome the possible scarcity of a resource. These mechanistic economists think about the economic process as a fundamentally reversible movement of the system, which is able to return to the balance, once done the necessary adjustments. They adopt a very weak sustainability approach in the so-called version "of the

abundance", and a weak approach in "accommodating" version. The supporters of the "techno-centrism of abundance" think that the research of individual well-being allows that the best solution for all is achieving, and that any problem of scarcity can be solved by the price system. It is the market that can manage this matter in the best way (D'Alisa, 2007, p.10-11)."

Figure 2.11: Methodological approaches/economic theories to sustainability

	Techno-centric		**Eco-centric**	
	of the Abundance	**Accommodating**	**Communitarian**	**Radical**
Characteristics	Exploitation of natural resources	Management and preservation of natural resources	Protection of natural resources	Extreme preservation of natural resources
Kind of economics	o Anti-green o No constraint o Growth oriented	o Green o Respect of constraint by means microeconomics policies o Sustainable growth oriented	o Deeply green o Respect of constraint by means macroeconomics and microeconomics policies o Sustainable development	o Rigorously green o Rigidly constraint for minimizing the impact of resource o de-growth oriented
Management strategies	o The prices, as scarcity indicators, assure the right signal to the agent perfectly free negotiating	o Necessity of adjustment considering the consequence of production and consume ways on environment o Pigou's taxes, sometimes quota productions o Operative rule: total capital constant in the time	o Stationary state no growth of physics resources. o Optimal scale, fair redistribution, optimal allocation o Plan of transferable permission o Operative rule: natural capital constant in the time	o De-growth of physics' resources o Level of population supported simply by organic agriculture o Fair redistribution
Ethics	o maximization of individual well-being	o Individual maximization is corrected to face some problems of intergenerational and infra-generational fairness o Nature has an instrumental value	o Present and future collectives interests, are predominant regarding the private and individual interests. o The ecosystems have a primary value	o Pursuing human interest as biological species o Ecosystems are the founding aspects of the life
Sustainability criterion	Very weak	Weak	Strong	Very strong

Source: R.K. Turner, D.W.Pearce e I.Bateman, Economia ambientale, Bologna, Il Mulino, 1996, pp.44-45 quoted after D'Alisa, 2007, p.11

The followers of "accommodating techno-centrism" think, instead, that it is necessary to reflect on the environmental topics. They consider the natural and human capital as fundamentally substituted goods, but they recognize that in some cases public intervention is necessary in order to keep environment healthy, and its principal services. Moreover, this approach recognizes that environment safeguard is important to support future economic growth. Eco-efficiency is the key-word of this approach and is achievable through the promotion of the so-called “green technologies”. Not differently from the techno-centric economists of abundance, they strongly believe in the techniques of economic appraisal and in a monetary estimation of the natural resource value, to quantify the value of the natural stock. The market and the accounting, adapted for the survey of some environmental data, would be the guide to the possible amount of sustainable consumption (La Camera, 2003; p.19-20 quoted after D’Alisa, 2007, p.10). “They recognize that the problem of redistribution is important but do not offer any new solution. This second approach is typical of environmental economists, whose aim is “sustainable growth”.

As for eco-centrism, the economists strongly interested in the study of ecology, think the scarcity of resources is ineluctable and deny that natural and artificial capital are substitute goods. They are the so called thermodynamic economists, who think that the economic process is biological and evolutionary and that economic activity is irreversible in its proceeding. They adopt a criterion of strong sustainability in its “communitarian version”, and a very strong criterion in the “radical version”. The "communitarian eco-centrists" adopt a systemic approach to solve environmental problems; they believe that the optimal allocation of Pareto cannot guarantee a positive evolution of the economic system. They are in favor of the promotion of sustainable development, a qualitative process without the material growth of economy. Before microeconomic adjustments, they think it needs to face two macroeconomic problems:

1. The problem of the optimal dimension of the economic subsystem regarding the environmental system that includes the former

2. The redistribution of the resources. The scale should guarantee the environmental, the social and the economic sustainability.

The approach to the strong sustainability characterizes the ecological economists; their aim is the sustainable development (D’Alisa, 2007, p.10).” Finally, the "radical eco-centrists” want a new foundation of the economy based on the acknowledgement of the ineluctability of the entropy law. According to this law, the flow of inner energy of society must be reduced to a minimum level, to allow life to go on in the future. Entropic economy is an economy of necessity not of luxury (Rifkin, 2000; p.401 quoted after D’Alisa, 2007, p.10). The new proposed economy is identifiable with the bio-economics of Georgescu-Roegen. He starts from the new theory of consumer and producer based on the maximization of no certain variable and a plurality of aims in a right proportion between competitive and cooperative behaviors. He underlines that a part cannot control the whole, the economic laws are not universal, renewing therefore the interest in the local dimension (Bonaiuti, 2003 quoted after D’Alisa, 2007, p.10). “This approach shares the entropic analysis with the accommodating eco-centrists, but it does not agree with their conclusions, as it refuses the stationary state as a solution, as well as the concept of sustainable development. Bio-economists stand for the de-growth (D’Alisa, 2007, p.10).”

Apparently the two first theories on Techno-centric cannot be completely suitable for this research. They have strong economic base and are either anti-green (of the Abundance) or green (Accommodating) but both believe that individuals and technology can overcome the possible scarcity of a resource. Such a belief weakens the meaning of sustainability accepted above because we do not consider the natural resources as terminable ones which we should try to use optimal in a long term. Although the sustainable criteria are not extremely strong in Communitarian Eco-centric, it is widely accepted and followed in this study. The pure, solid and one dimensional approach to environmental issues will undermine the other aspects of the study. As mentioned in figure 2.11, the goal is to protect natural resources such as green lands but the extreme preservation and rigorously green cannot always be feasible in real urban areas. It other words, a balance between the built and the natural environment in urban spaces described by UNESCO EOLSS in figure 2.7 is the final goal.

2.2 Climate change and sustainable development

"Concern about global warming led the World Meteorological Organization and the United Nations Environment Program jointly to establish the Intergovernmental Panel for Climate Change (IPCC) in 1988. Its first assessment report came out in 1990 and attributed recent increase in average global temperature to a buildup of greenhouse gases in the atmosphere, suggesting that this was principally due to human activities and especially the burning of fossil fuels (Van Kooten, 2013, p.285)." As mentioned above, the leaders assembled in Rio de Janeiro in 1992 signed the UN Framework Convention on Climate Change (UNFCCC). They actually recalled the pertinent provisions of the Declaration of the United Nations Conference on the Human Environment, adopted at Stockholm on 16 June 1972 and were concerned that human activities have been substantially increasing the atmospheric concentrations of greenhouse gases, that these increases enhance the natural greenhouse effect, and that this will result on average in an additional warming of the earth's surface and atmosphere and may adversely affect natural ecosystems and humankind (UNFCCC, 2014). At the second conference of the parties (COP) to the UNFCC, which was held in Paris, nations endorsed the IPCC's second assessment report. Then, at COP3 held at Kyoto, Japan, in December 1997, the industrialized nations agree by 2008-2012 to reduce their collective emissions of Co_2 and equivalent greenhouse gases, together known as CO_{2e}(or just CO_2), to an average of 5.2% below 1990 concentration values. At COP7 held at Marrakech in Morocco, a final agreement was reached concerning the particular offsets that would be eligible, and the IPCC's third assessment report was endorsed (Van Kooten, 2013, p.285).

In the article one of this convention climate change is defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 2014)."

The cause-effect cycle and consequences of climate change has been explained by ESA in Sustainable Development 2009-10 Report as following points:

- Within a few generations, humankind is likely to exhaust the fossil-fuel energy resources that were formed over several hundred million years.
- As a consequence, atmospheric greenhouse-gas concentrations have risen far beyond the maxima reached during the last million years at least.
- Human action has transformed almost half of earth's land surface, with significant consequences for biodiversity and climate change.
- Tropical forest areas have been reduced by 50%.
- More than half of all accessible freshwater (less than 3% of the water available on earth) is used directly or indirectly by humankind.
- Coastal and marine habitats are being dramatically altered, 50% of mangroves have been removed, wetlands having shrunk by half.
- Species extinction rates are rising sharply in marine and terrestrial ecosystems around the world.

2.2.1 The importance of climate change

The importance of this research can better be perceived by highlighting the importance and impacts of climate change. Trevor et al. (2011) discuss the evidence of the impact of climate warming on plant, insect and bird phenology by examining (1) phenotypic plasticity[1] in (a) budburst in trees, (b) appearance of insects and (c) migration of birds; and (2) genetic adaptation in (a) gene expression during bud burst in trees, (b) the timing of occurrence of phonological event in insects and (c) arrival and breeding times of migratory birds (Trevor et al., 2011, p.179).

With a rapidly changing climate that brings about rising average global temperatures increasing frequency of extreme weather events, and new pests and diseases, trees may no longer be able to adapt to their changing

[1] Phenotypic plasticity is a mechanism by which an organism can adjust the timing of development in response to environmental pressures (Bradshaw, 1965 quoted after Trevor et al., 2011, p.178).

environment. The only solutions for the survival of the trees are to rapidly adapt to the changing conditions or to migrate to ecological niches that are more suitable (Aitken at al., 2008 quoted after Trevor et al., 2011, p.179)." "It is important to know whether or not plant species can respond to this rapid change in climatic conditions and, if so, how fast they can do this. Unlike insects and birds, plants cannot readily migrate when environment conditions change rapidly (Savolainen et al., 2007, quoted after Trevor et al., 2011, p.181)."

"Migratory birds are particularly vulnerable to global climatic change, as their complex annual life cycle involves breeding, moult and two migration events, all of which are influenced by temperature (Trevor et al., 2011, p.188)." "If organism cannot keep pace with the changes in their environmental conditions, by means of either phenotypic plasticity or genetic adaption, the consequences will be severe and extinction is a clear possibility (Trevor et al., 2011, p.194)."

Thus, on one hand, losing the trees destructs the natural ecosystem and can be one of the causes of climate change, as there will not be enough trees to filter the green house gases. On the other hand, climate change itself has impact on trees and destroys the green area by hard adaptation of the trees to the new environment and air pollution which ruins the fruits and leaves' texture of the trees. Hence, trees' destruction will cause a destructive vicious loop which worsens the entire condition of human life and has double negative effect. This debate will be explained in Iran in the criteria of chapter 6.

"As noted by the New York Times (Dec.2010), agriculture is likely the sector to be the most impacted and damaged by climate change. The risks of rising atmospheric Co_2 include melting ice sheets, rising seas, more droughts and heat waves, more flash floods, worse storms, extinction of many plants and animals, depletion of sea life and-perhaps most important-difficulty in producing an adequate supply of food. Early estimates of potential climate change damages in agriculture employed crop simulation models and assumed a "dump" farmer, who would continue to plant the same crops with the same methods as those employed prior to the change in climate conditions (Van Kooten, 2013, p.225)." In the case of Iran, climate change and continuing the same old methods by the farmers have led to the decrease in quantity and quality of the crops and consequently the land use conversion which itself worsens the climate change effects. This will be more explained in the criteria of chapter 6.

Health is potentially a field in which there might be significant damages caused by global warming. Global warming poses a threat to human primarily because of the projected spread of malaria and other tropical diseases. However, tropical diseases are a problem of economic development and preventive health, not of rising global temperature. In terms of empirical studies of the costs to health of climate change, Moore (1998) estimates that an average global temperature increase of 4.5 °C will yield some $30-$100 billion in health benefits (not losses) to U.S. residents. Gloklany (2008-2009) also reports that global warming actually reduces mortality rates as fewer people will die from exposure to cold temperatures. It seems that people are better able to cope with warmer temperatures than colder ones.

Prior to 1989, droughts were by far the most important contributing factor to mortality, mainly because poor countries were least able to cope with drought. Floods were the second most important weather-related cause of death, followed by windstorms. Extreme temperatures ranked sixth out of seven weather-related events as contributed to mortality. For the period 1990 through 2006, death rates from all weather-related causes dropped dramatically as nations learned how to cope with severe weather events and as a result of relief efforts by rich countries. However, annual death rates fell for all categories, with the exception of extreme temperature events (Van Kooten, 2013, p.247-251). This debate is discussed about Iran in the climate change section of chapter 3.

The economics of climate change has to be emphasized as green gases are an economic problem as they impose an externality. Therefore they are associated with the market failure. An externality occurs when the benefits or costs of an economic agent's actions fall on other economic agents, and these benefits or costs are not accounted for by the agent responsible. Greenhouse gases represent a negative externality and the emitter does not have to pay for these costs and disruptions. Markets therefore fail, in the sense that they generate prices that they do not reflect the true cost to society of our economic activities. Greenhouse gases entail a

unique externality for several reasons: they are global in scope and impacts; they involve significant uncertainty and risk in the scientific chain of causation; they are long term and governed by a stock-flow process (in the atmosphere); and the effects are potentially huge and irreversible. There is general consensus across the economics profession that a price on greenhouse gases is an essential part of the policy response. In addition, the science and the economics suggest that, because a tone of carbon dioxide does the same damage wherever it is emitted, this piece should be the same everywhere (Held, 2011, p.72-73).

In addition to the debate about its physical effects and the economic costs and benefits of addressing it, climate change also involves questions of power, social justice and distribution which will be explained at the end of this chapter (Held et al., 2011, p.5).

2.2.2 Air pollution, climate change and human health

Air quality in many parts of the world is poor due to emissions of various pollutants such as sulphur dioxide (SO_2), nitrogen oxides (NO and NO_2), volatile organic compounds (VOCs), particulates and so on. Many air pollutants remain in the atmosphere for long periods of time and often travel long distances thus affecting both the local and the global environment. In addition to causing global warming, acidification and other environmental effects, air pollution can also affect human health. On one hand, addressing the problem of air pollution is an important issue in sustainable development (Azapagic, 2004, p.85). On the other hand, as CO_2 has a significant role in climate change and global warming debates, air pollution can be considered as a part of the climate change subject.

The main air pollution indexes are known as Particulate matter, CO, NO_2, SO_2, Pb and ground level ozone which will be explained briefly below:

"Particulate matter, also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories:

- "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.
- "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.

Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. Nationally and, particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

Nitrogen dioxide (NO_2) is one of a group of highly reactive gasses known as "oxides of nitrogen," or "nitrogen oxides (NO_x)." Other nitrogen oxides include nitrous acid and nitric acid. While EPA's National Ambient Air Quality Standard covers this entire group of NO_x, NO_2 is the component of greatest interest and the indicator for the larger group of nitrogen oxides. NO2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system.

Sulfur dioxide (SO_2) is one of a group of highly reactive gases known as "oxides of sulfur." The largest sources of SO_2 emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO_2 is linked with a

number of adverse effects on the respiratory system. EPA (Environmental Protection Agency) first set standards for SO_2in 1971. EPA set a 24-hour primary standard at 140 ppb and an annual average standard at 30 ppb (to protect health). EPA also set a 3-hour average secondary standard at 500 ppb (to protect the public welfare).

Lead (Pb) is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been from fuels in on-road motor vehicles (such as cars and trucks) and industrial sources. As a result of EPA's regulatory efforts to remove lead from on-road motor vehicle gasoline, emissions of lead from the transportation sector dramatically declined by 95 percent between 1980 and 1999, and levels of lead in the air decreased by 94 percent between 1980 and 1999. Today, the highest levels of lead in air are usually found near lead smelters. The major sources of lead emissions to the air today are ore and metals processing and piston-engine aircraft operating on leaded aviation gasoline.

Ground level ozone can have harmful effects on sensitive vegetation and ecosystems. Plant species that are sensitive to ozone and potentially at an increased risk from exposure include trees such as black cherry, quaking aspen, ponderosa pine and cottonwood. These trees are found in many areas of the country. These effects can also have adverse impacts on ecosystems, including loss of species diversity and changes to habitat quality and water and nutrient cycles (EPA, 2012)."

The constituents of the atmosphere which absorb the emitted radiation are known as greenhouse gases. The principal greenhouse gas is carbon dioxide (CO_2). Other significant greenhouse gases are methane (CH_4), water vapor and nitrous oxide (N_2O) and the gases which contribute to the greenhouse effect are CFCs, HFCs and O3 (Azapagic, 2004, p.87). The acid gases, which include SO_2, NO, $NO_2$and ammonia (NH3), are dispersed in the atmosphere and can travel long distances before being deposited on the ground or in waterways. Deposition can be by both wet and dry mechanisms (Azapagic, 2004, p.89)."

"Once deposited, acid gases can reduce the PH of water or soil to values as low as 3. Thus they can cause great physical damage to crops, forests, watercourses and to the external surfaces of the buildings. Acidification can also leach (dissolve) metals from soils and clays into solutions which are sufficiently concentrated to be toxic to freshwater fish and other species. Further environmental damage from disposition of nitrogen-containing gases such as NO_x and NH_3 occurs due to nutrient enrichment of terrestrial and aquatic ecosystems with resulting increase in growth of biomass. This effect is known as eutrophication (Azapagic, 2004, p.89)."

As the mentioned gases have a large measurable increase in the atmosphere, the IPCC predicts, a rise in mean global temperatures of between 1.4 and 5.8°C could be expected by the end of 21 century (IPCC, 2001 quoted after Azapagic, 2004, p.87). In many parts of the world, particularly in large cities, in addition to causing the global and regional above effects, the combined effect of SO_2, NO_x, CO_2, CO, VOCs and solid particles of dust, ash and soot can cause a number of local air-pollution effects and consequently winter and summer smog in urban atmosphere. The main constituents of winter smog are $SO_2$and particles, whose emissions increase in the winter months in the areas which use coal for heating. A direct link between these pollutants and increased illness and mortality was first established in the 1950s in London where, in one week alone, 4000 people dies due to prolonged winter-smog episodes. Summer or photochemical smog, on the other hand, occurs in the summer months due to reactions between NO_x and VOCs and unburned hydrocarbons in the presence of UV radiation from the sun and can cause respiratory problems and eye irritations in humans and can affect vegetation through oxidation process (Azapagic, 2004, p.91).

Concerning health problems caused by air pollution or better to say climate change, there are immediate and obvious effects and others which develop during the time. According to an EU study in 15 large cities, the rate of hospital admissions does vary depending on the state of atmosphere: increases of 50$\mu g/m^3$in NO_2 levels above the background level were estimated to lead, within hours or a few days, to an increase of 2.6% in hospital admissions for asthma treatment. The same in NO_2 levels leads to a 1.9% increase in admission for lung conditions. Based on COMEAP in 1998, deaths from all causes are increased by 3.5% for every increase of 100$\mu g/m^3$in daily average of NO_2 level (Azapagic, 2004, p.92).

Air pollution costs not only human health and lives, but also money. Another UK report estimated that in 1996/1997 the cost of admissions to hospitals for respiratory diseases related to air pollution cost Government and the tax payer in total £566 million or £1400 per person per spell in hospital. The information about this study is mostly related to three reliable data: PM_{10}, SO_2 and tropospheric ozone (Department of Health, 1999 quoted after Azapagic, 2004, p.92).

In Donora, Pennsylvania, in 1948 a fog was coincident with a temperature inversion that persisted for 4 days.Continued emissions from a steel mill and zinc and sulfuric acid plants caused severe air pollution, with SO_2 estimated 0.5-2 ppm and large concentrations of particles. Out of a population of 14,100,20 people, 20 people died; there was also a great morbidity, with about 43% of the population made ill, 10% of them severely so (Freedman, 1995, p.27).

It should be stressed that, the above cases represent severe episodes of air pollution. The effects on human health of more typical, non-episodic, urban air quality have also been investigated. However, the conclusions with respect to enhance morbidity or mortality are much more tentative and controversial (Coffin and Stokinger, 1978 quoted after Freedman, 1995, p.27-28).

“About 25 million people, including 7 million children, have asthma and over 12 million people report having an asthma attack in the past year. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Ground level ozone also can reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue (EPA, 2012).” The statistics about the Iran situation is presented in chapter 3.

2.2.3 The importance role of carbon dioxide

The role of Co_2 and other greenhouse gases as a driver (forcer) of climate change has to be clear in the research. On the other hand the importance of trees as filters for Co_2 can better be highlighted when the role of Co_2 is defined. In contrary to what many people believe Co_2 will not cause global warming itself, Co_2 is a minor contributor to climate change; the argument is that the rise in Co_2 causes an initial warming that triggers greater evaporation of water from the oceans, thereby increasing the height of moist air in the atmosphere. The climate models predict that, as the planet warms, the layer of moist air expands upwards into the cool dry air above, and that this will occur firstly over the topics to a height of a bout 10km. this is where the initial rise in temperature will be observed. Hence, it is this increase in atmosphere of the potent greenhouse gas water vapor that results in significant warming-the initial Co_2 - induced warming is insignificant by comparison (Van Kooten, 2013, p.118).

Although on an equal mass basis Co_2 is a less potent global warming agent than the other greenhouse gases (e.g. 1kg methane has about 21 times the global warming potential of 1kf of Co_2 averaged over 100 years), the quantity of Co_2 emission is so large that it remain the main contributor to global warming (Azapagic, 2004, p.87).

2.2.4 Environmental quality standards for air pollution

There are different standards published by different organizations for the air pollution indexes. “The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. *Primary* standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. *Secondary* standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below in Figure 2.12. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (µg/m3) (EPA, 2011).”

One of the other standards which is the most commonly used air quality index in the UK is the Daily Air Quality Index recommended by the Committee on Medical Effects of Air Pollutants (COMEP). COMEAP provides independent advice to government departments and agencies on how air pollution impacts on health. Its members come from a range of specialist fields such as air quality science, atmospheric chemistry, toxicology, physiology, epidemiology, statistics, pediatrics and cardiology. There is also a lay member, who helps ensure that the general public can access and understand the committee's work. This index has ten points, which are further grouped into 4 bands: low, moderate, high and very high. Each of the bands comes with advice for at-risk groups and the general population (Figure 2.13).

Figure 2.12: National Ambient Air Quality Standards (NAAQS) by Environmental Protection Agency (EPA)

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: EPA, 2011

Figure 2.13: Health advice to accompany to air quality index according to COMEAP

Air pollution banding	Value	Health messages for At-risk individuals	Health messages for general population
Low	1-3	Enjoy your usual outdoor activities.	Enjoy your usual outdoor activities.
Moderate	4-6	Adults and children with lung problems, and adults with heart problems, who experience symptoms, should consider reducing strenuous physical activity, particularly outdoors.	Enjoy your usual outdoor activities.
High	7-9	Adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce physical exertion.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should consider reducing activity, particularly outdoors.
Very High	10	Adults and children with lung problems, adults with heart problems, and older people, should avoid strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.	Reduce physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

Source: Ayres. J G, 2011, p.5

The index is based on the concentrations of five pollutants. The index is calculated from the concentrations of the following pollutants: Ozone, Nitrogen Dioxide, Sulphur Dioxide, PM2.5 Particles, and PM10 Particles. The breakpoints between index values are defined for each pollutant separately and the overall index is defined as the maximum value of the index. Different averaging periods are used for different pollutants (Ayres. J G, 2011, p. 44). Table 2.1 indicates air pollution indexes according to COMEAP standards. The information regarding air pollution indexes of Tehran and their comparison with above universal standards are presented in chapter 3 and 2 step criteria of chapter 5 to choose the case studies in Tehran regions.

Table 2.1: Air pollution indexes according to COMEAP

Index	Ozone, Running 8 hourly mean (µg/m3)	Nitrogen Dioxide, Hourly mean (µg/m3)	Sulphur Dioxide, 15 minute mean (µg/m3)	PM10 Particles, 24 hour mean (µg/m3)	PM2.5 Particles, 24 hour mean (µg/m3)
1	0-33	0-66	0-88	0-11	0-16
2	34-65	67-133	89-176	12-23	17-33
3	66-99	134-199	177-265	24-34	34-49
4	100-120	200-267	266-354	35-41	50-58
5	121-140	268-334	355-442	42-46	59-66
6	141-159	335-399	443-531	47-52	67-74
7	160-187	400-467	530-708	53-58	75-83
8	188-213	468-534	709-886	59-64	84-91
9	214-239	535-599	887-1063	65-69	92-99
10	≥ 240	≥ 600	≥ 1064	≥ 70	≥ 100

Source: Ayres. J G, 2011, p.2

2.2.5 The effects of urban trees on air quality

"Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmospheric environment. The four main ways that urban trees affect air quality area: Temperature reduction and other microclimatic effects, removal of air pollutants, emission of volatile organic compounds (VOCs) and tree maintenance emissions, energy effects on buildings (Nowak, 2002, p.1)."

"Trees in parking lots can also affect evaporative emissions from vehicles, particularly through tree shade. Increasing parking lot tree cover from 8% to 50% could reduce Sacramento County, CA, light duty vehicle VOC evaporative emission rates by 2% and nitrogen oxide start emissions by less than 1% (Scott et al., 1999 quoted after Nowak, 2002, p.2)."

"Tree transpiration and tree canopies affect air temperature, radiation absorption and heat storage, wind speed, relative humidity, turbulence, surface albedo, surface roughness and consequently the evolution of the mixing-layer height. These changes in local meteorology can alter pollution concentrations in urban areas (Nowak et al., 1998 quoted after Nowak, 2002, p.1). Although trees usually contribute to cooler summer air temperatures, their presence can increase air temperatures in some instances (Myrup et al., 1999 quoted after Nowak, 2002, p.1). In areas with scattered tree canopies, radiation can reach and heat ground surfaces; at the same time, the canopy may reduce atmospheric mixing such that cooler air is prevented from reaching the area. In this case, tree shade and transpiration may not compensate for the increased air temperatures due to reduced mixing (Heisler et al., 1995 quoted after Nowak, 2002, p.1). Maximum mid-day air temperature reductions due to trees are in the range of 0.04 ºC to 0.2 ºC per percent canopy cover increase (Simpson, 1998 quoted after Nowak, 2002, p.1). Below individual and small groups of trees over grass, mid-day air temperatures at 1.5 m above ground are 0.7 ºC to 1.3 ºC cooler than in an open area (South, 1993 quoted after Nowak, 2002, p.1). Reduced air temperature due to

trees can improve air quality because the emission of many pollutants and/or ozone forming chemicals is temperature dependent. Decreased air temperature can also reduce ozone formation (Nowak, 2002, p.1)."

"Trees remove gaseous air pollution primarily by uptake via leaf stomata, though some gases are removed by the plant surface. Once inside the leaf, gases diffuse into intercellular spaces and may be absorbed by water films to form acids or react with inner-leaf surfaces. Trees also remove pollution by intercepting airborne particles. Some particles can be absorbed into the tree, though most particles that are intercepted are retained on the plant surface. The intercepted particle often is re-suspended to the atmosphere, washed off by rain, or dropped to the ground with leaf and twig fall (Smith, 1990 quoted after Nowak, 2002, p.1)." Consequently, vegetation is only a temporary retention site for many atmospheric particles.

"Trees reduce building energy used by lowering temperatures and shading buildings during the summer, and blocking winds in winter (Heisler, 1986 quoted after Nowak, 2002, p.2). However, they also can increase energy use by shading buildings in winter, and may increase or decrease energy use by blocking summer breezes. Thus, proper tree placement near buildings is critical to achieve maximum building energy conservation benefits. When building energy use is lowered, pollutant emissions from power plants are also lowered. While lower pollutant emissions generally improve air quality, lower nitrogen oxide emissions, particularly ground-level emissions, may lead to a local increase in ozone concentrations under certain conditions due to nitrogen oxide scavenging of ozone (Rao et al., 1993 quoted after Nowak, 2002, p.2)." "The cumulative and interactive effects of trees on meteorology, pollution removal, and VOC and power plant emissions determine the overall impact of trees on air pollution (Nowak, 2002, p.2)."

"There are also "combined effects" of trees in air pollution. Changes in urban microclimate can affect pollution emission and formation, particularly the formation of ozone. A model simulation of a 20 percent loss in the Atlanta area forest due to urbanization led to a 14 percent increase in ozone concentrations for a modeled day (Cardelino, 1990 quoted after Nowak, 2002, p.3)." "Although there were fewer trees to emit VOCs, an increase in Atlanta's air temperatures due to the urban heat island, which occurred concomitantly with tree loss, increased VOC emissions from the remaining trees and anthropogenic sources, and altered ozone chemistry such that concentrations of ozone increased (Nowak, 2002, p.3)."

"There have been many examples of the impact of trees on the urban lives and air pollution. In 1994, trees in New York City removed an estimated 1,821 metric tons of air pollution at an estimated value to society of $9.5 million. Air pollution removal by urban forests in New York was greater than in Atlanta (1,196 t; $6.5 million) and Baltimore (499 t; $2.7 million), but pollution removal per m2 of canopy cover was fairly similar among these cities (New York: 13.7 g/m2/yr; Baltimore: 12.2 g/m2/yr; Atlanta: 10.6 g/m2/yr) (Dowak et al., 2000 quoted after Nowak, 2002, p.1)."

"These standardized pollution removal rates differ among cities according to the amount of air pollution, length of in-leaf season, precipitation, and other meteorological variables. Large healthy trees greater than 77 cm in diameter remove approximately 70 times more air pollution annually (1.4 kg/yr) than small healthy trees less than 8 cm in diameter (0.02 kg/yr) (Nowak, 1994d quoted after Nowak, 2002, p.1)." That is the reason why preservation obtains more value than plantation of green, it means that with an appropriate preservation plans for large trees and their maintenance, first of all, more air pollution can be reduced and second of all less money has to be invested for new trees and a vacant suitable piece of land for planting them. Consequently this research gives the first priority to the preservation of the old thick existing trees of Tehran than creating new green spaces and the main content is therefore preservation.

"Air quality improvement in New York City due to pollution removal by trees during daytime of the in-leaf season averaged 0.47% for particulate matter, 0.45% for ozone, 0.43% for sulfur dioxide, 0.30% for nitrogen dioxide, and 0.002% for carbon monoxide. Air quality improves with increased percent tree cover and decreased mixing-layer heights. In urban areas with 100% tree cover (i.e., contiguous forest stands), short-term improvements in air quality (one hour) from pollution removal by trees were as high as 15% for ozone, 14% for sulfur dioxide, 13% for

particulate matter, 8% for nitrogen dioxide, and 0.05% for carbon monoxide (Dowak et al., 2000 quoted after Nowak, 2002, p.1)."

"A model simulation of California's South Coast Air Basin suggests that the air quality impacts of increased urban tree cover may be locally positive or negative with respect to ozone. The net basin wide effect of increased urban vegetation is a decrease in ozone concentrations if the additional trees are low VOC emitters (Taha, 1996 quoted after Nowak, 2002, p.3)." "Modeling the effects of increased urban tree cover on ozone concentrations from Washington, DC to central Massachusetts reveals that urban trees generally reduce ozone concentrations in cities, but tend to slightly increase average ozone concentrations in the overall modeling domain. Interactions of the effects of trees on the physical and chemical environment demonstrate that trees can cause changes in pollution removal rates and meteorology, particularly air temperatures, wind fields, and mixing-layer heights, which, in turn, affect ozone concentrations. Changes in urban tree species composition had no detectable effect on ozone concentrations (Nowak et. al., 2000 quoted after Nowak, 2002, p.3). "Modeling of the New York City metropolitan area also reveal that increasing tree cover 10% within urban areas reduced maximum ozone levels by about 4 ppb, which was about 37% of the amount needed for attainment (Nowak, 2002, p.3)."

2.2.6 Solutions and adaptation of climate change

One of the main solutions for climate change adaptation is planting more green or preservation of the existing trees explained above. Considering trees as a solution for air filtration in urban texture, there are couples of strategies to improve the air quality include:

- Increase the number of healthy trees (increases pollution removal).
- Sustain existing tree cover (maintains pollution removal levels).
- Maximize use of low VOC emitting trees (reduces ozone and carbon monoxide formation).
- Sustain large, healthy trees (large trees have greatest per tree effects).
- Use long-lived trees (reduces long-term pollutant emissions from planting and removal).
- Use low maintenance trees (reduces pollutants emissions from maintenance activities).
- Reduce fossil fuel use in maintaining vegetation (reduces pollutant emissions).
- Plant trees in energy conserving locations (reduces pollutant emissions from power plants).
- Plant trees to shade parked cars (reduces vehicular VOC emissions).
- Supply ample water to vegetation (enhances pollution removal and temperature reduction).
- Plant trees in polluted areas or heavily populated areas (maximizes tree air quality benefits).
- Avoid pollutant sensitive species (increases tree health).
- Utilize evergreen trees for particulate matter reduction (year-round removal of particles) (Nowak, 2000 quoted after Nowak, 2002, p.3)

Moreover, Europe's responsibilities can be summarized as following: enabling transfers from rich to poor countries to help them leapfrog straight to low-carbon energy. The EU Emissions Trading is the foundation for this. Second, the world needs to accelerate global investment in green technology which EU has the critical mass for. Third, the world needs open global markets in agriculture and increase global investment in low-carbon R&D. The developed world's agricultural policies cost developing countries about $1.7 billion each year- about five times the amount of oversees development assistance spent on agriculture (Held, 2011, p.191-192).

Four instruments are available to policymakers for reducing greenhouse gas emissions: (1) regulation, (2) a carbon tax, (3) 'cap and trade', and (4) subsidies (the flip side of tax). Cap and trade requires the authority to set a cap on allowable emissions from large industrial emitters followed by trade to allocate emission permits in an optimal fashion. A weaker version of cap and trade allows emission reduction offsets to substitute for the allowances created by the cap. Offsets can come from biological sinks (e.g., carbon sequestered in trees) in the same jurisdiction, activities that reduce emissions in non-covered jurisdictions such as developing countries (e.g., investments that make burning coal at an existing power plant more efficient) (Van Kooten, 2013, p.49, 293).

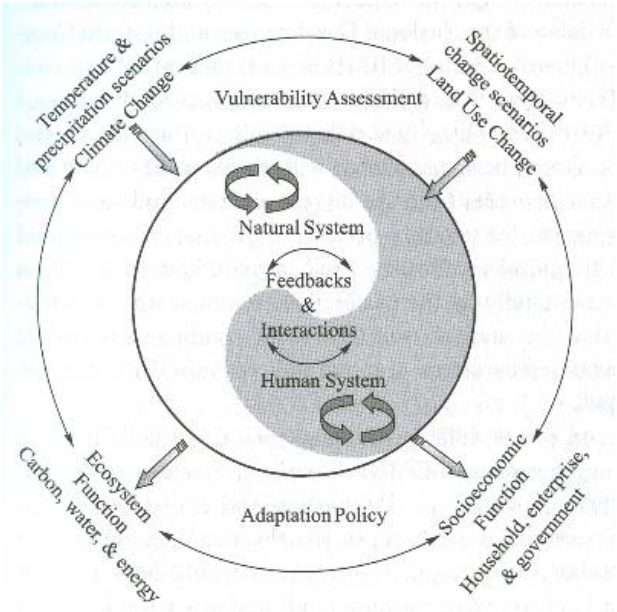
According to cap and trade supporters, it makes the most sense of options available because it allows for greater certainty about eventual emissions levels and provides better incentives for producers (Held et al., 2011, p.8).

Taxes and emissions trading are market instruments, while regulation is a form of command and control. Regulation and cap and trade are often considered more effective than taxes because the authority may set the tax too low to achieve the target. Economists generally distrust subsidies because of its political and distorting effects. They also dislike regulations because it is less efficient than a price (tax) or quantity (cap and trade) instrument. Indeed, it is quite easy to demonstrate that the regulatory approach lacks incentives and is more costly than a market approach (Van Kooten, 2013, p.49, 293).

The weather Index Insurance has been promoted by agricultural economists in lieu of crop insurance. No crop insurance can eliminate the problem of moral hazard, which occurs because, once farmers are in a crop insurance program, they take no steps to reduce their risks of exposure to drought. The advantages of weather index insurance are several. First, weather index eliminates the problems of adverse selection because participation by one farmer does not affect the premium that other farmers would pay. Second, it eliminates the problem associated with moral hazards, because the farmer cannot influence the weather, she cannot affect the payout. Finally, weather indexes can be quite simple, what is needed is a record of temperature and precipitation.

Global climate change, human activities via various land-use practices and natural disturbances are considered the primary drivers for ecosystem functions and services of any region. Chen et al. in their book called *Dryland Eeast Asia: Land dynamics amid social and climate change*, have proposed a conceptual framework (Figure 2.14) for exploring the linkages between biophysical and socioeconomic parameters as well as their coupled effects on the interactions and feedbacks within and between the human system (HS) and natural system (NS) towards science-based adaption plans for the region. They believe that climate change and human stresses will place unequal pressure on each element of HS and NS matrices (Chen, 2013, p.16-17). This framework is a multidimensional model for policy making in the field of climate change adaption and almost based on the dimensions accepted for sustainable development. That is to say, as climate change is also a debate in sustainable development, the adaption policies are also according to its dimensions. Land use change can be categorized as institutional dimension which is related to regulations by policy makers. The final policies of this study will take this model into consideration.

Figure 2.14: Proposed conceptual framework for adaption policies for climate change by Chen, et al.



Source: Chen, 2013, p.374

One of the other solutions for decreasing the effects of climate change and prevent the ecological destructive procedures in the cities is *ecological monitoring*. Because of widespread concerns about ecological changes, many countries are designing and implementing longer-term programs of ecological monitoring and research. These programs deal with changes over large areas and are multi-and interdisciplinary activity, involving repeated measurements of inorganic, ecological, social, or economic variables, with a view to documenting or predicting important changes over time (Freedman, 1995, p.455). They should consist of two integrated activities-monitoring and research (Freedman et al., 1993c quoted after Freedman, 1995, p.455).The interpretation of environmental-monitoring data requires an understanding of linkages among the components and processes of complex systems. The ultimate goals of ecological monitoring programs are: (1) to detect or anticipate ecological changes, by measuring appropriate indicators, and (2) to understand the causes and consequences of those changes (Freedman, 1995, p.455-456). This solution is still missing in Iran eco-urbanism which is better explained in the derived criteria of chapter 6.

Another solution to deal with climate change problems and the related issues is *System Thinking*. "It is only through thinking of change through systems and their clusters and path dependencies that we can appreciate the enormous task involved in shifting rapidly and globally from high carbon lives to low carbon lives (Urry, 2011, p.42). "By emerging the systems thinking to planning and evolution of the planning process at the end of 1950 and the beginning of 1960, evaluation has more and more been considered as a crucial element of this process which will be executed in this research in methodology by means of AHP model. The choice of this methodology strengthens the system thinking and multidimensional base of the study.

The essence of systems thinking is to see inter-relationships rather than linear cause-and-effect chains and processes of change rather than snapshots. Systems thinking is a way of interpreting the universe as a series of interconnected and inter-related wholes. It is a way of identifying the inherent organization within a complex situation and has been called organized complexity. Systems thinkers contrast dynamic complexity (the relationships between things) with detail complexity (details about things).

It is an approach, a set of general principles and specific tools and techniques, rather than a subject area in its own right; it can be applied within many different fields and is therefore described as a meta-discipline (Broad 1923, Smuts 1924 quoted after Checkland, 1999, p.15)."

"System thinking embraces holism (viewing the big picture) and pluralism (getting everyone involved), which strict reductionism and dogmatism, respectively" (Reynolds and Holwell, 2010 quoted after Chen, 2013, p.374). "We need diversity of viewpoints, which involves identifying and including the input of relevant stakeholders (Costanza et al., 1997; Sandker et al., 2008 quoted after Chen, 2013, p.374)."

"A system is composed of multiple components, elements or parts that work together or interact for a common *purpose* (Forrester, 2007; Meadows, 2008 quoted after Chen, 2013, p.374)." Simon and Newall (as cited in Dale, 1970, 1973) described this as one of the basic modes of human problem-solving: i.e., take a bid insoluble problem, repeatedly decompose it into smaller and smaller sub-problems until eventually each sub-problem is soluble, and then sum the individual solutions to obtain a solution of the original problem (Chen, 2013, p.374). When one knows how to identify the critical components of a problem, this method can work well in solving complex, multidimensional problems. Often, climate change related issues in the cities have this character and can better be perceived and solved through system thinking and decomposition.

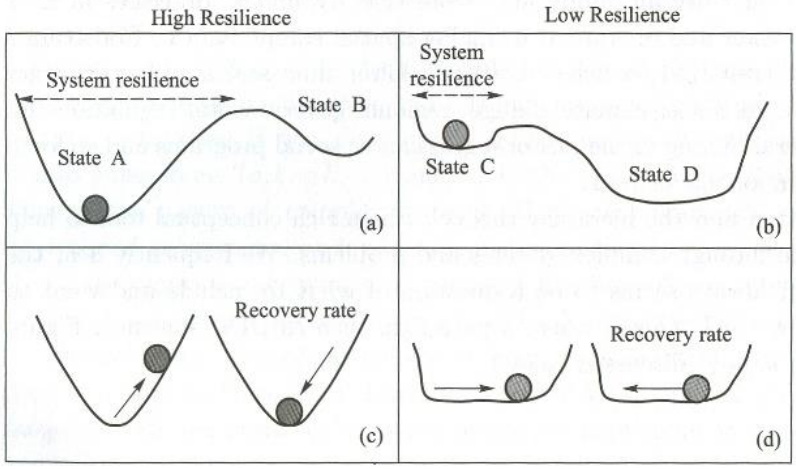
The nature of complex problems is hierarchical, composed of interrelated subsystems, each of which includes other subsystems. How far we should decompose the system is of course the function of our interests and the spatiotemporal scales we wish to work with. In other words, each subsystem has characteristic rates of change, cycle times, response time, etc (Chen, 2013, p.376).

In the case of Tehran, the green lands' destruction is also a complex system of interrelated subsystems and the entire case itself is a part of climate change discussions; therefore, it has to be decomposed to smaller elements which are the dimensions of sustainable development as well. To solve the whole problem with its intricacy, the system thinking is required to decompose the hierarchical system into more understandable, simpler and more

definable items. This is done in chapter 6 when the author describes the derived criteria based on the decompositions.

To decompose the system into its elements the main issue and its intensity has to be clarified. This is done through system resilience shown in figure 2.15. Resilience addresses the dynamic and development of complex social-ecological systems (Folke et al., 2010 quoted after Chen, 2013, p.378). Holling (1973) gave the classic definition of resilience that focuses the ability of a system to persist despite disturbances, i.e., the amount of change that a system can endure before it crosses a threshold and moves in an alternative state. Resilience is typically visualized using the metaphor of a landscape composed of hills, valleys and balls. Balls are scattered at various locations in the landscape to represent the current location or state of a system; valleys represent "attractor states" and the degree of system resilience is represented as the size of the valley or basin of attraction: that is, the maximum perturbation that a system can absorb without shifting to an alternative state. As indicated in figure 2.15 (a) State A can absorb a large disturbance before being nudged out of the valley, up over the steep hill, to state B. (b) even a small perturbation can drive state C to D (low hill). (c) This system has a steep valley and thus a fast recovery rate. (d) Given the flat valley, this system will have a slower recovery rate (modified from van Nes and Scheffer, 2007 quoted after Chen, 2013, p.378).

Figure 2.15: System resilience



Source: Chen, 2013, p.17

As it is explained in chapter 3 about the Tehran climate change status and chapter 5 about how and with what speed the green lands have been destroyed from 1955 up to the present in Tehran, the system resilience model which can be illustrated for Tehran in a combination of (a) and (d). Similar to (a) the environmental system in Tehran has had a high resilience before being nudged out of the valley, with other words the threshold has been high and despite the high intensity of environment destruction in Tehran, the city is still functioning; but due to the scientists' ideas it is not very far from reaching the threshold and falling down to recovery rate in (d). As stated in sustainable development theories and the eco-centric (Communitarian) believe the destroyed natural resources cannot be recreated and as a result the recovery phase will take a long time for Tehran to take back the clean air, destroyed green land, land use conversion and adapt itself to climate change. All in all this analysis-model for Tehran shows the importance of this study to postpone the ball in reaching the threshold point, because when the ball reaches the top of the hill in Tehran, it cannot easily be stopped or taken back by just setting policies and regulations. One of the policies which can be made is in the field of "Conservation" or "Preservation" which will be explained further.

2.3 Conservation and sustainable development

Some people believe that public land should be managed by the method of conservation, meaning that the environment and its resources should be used by humans and managed in a responsible manner. This viewpoint requires that the environment is used in a way that is sustainable, and it ensures that the natural resources will be

used in a manner that will meet the present day needs for the resource without jeopardizing the supply of the resource for future generations (Education Portal, 2014). This is the point where conservation and sustainable development meet and conservation become an element of sustainable development

"Conservation is the wise use of natural resources to benefit the greatest numbers of people, for the longest time. The term conservation was introduced in 1907 by Gifford Pinchot and W.J. McGee to embrace the collective use and preservation of forests, waters, soils, and minerals (University of Colorado, 2000)." "Gifford Pinchot, who lived from 1865 to 1946, was a leader in the conservation movement. As the United States expanded and more land was being converted for human use, Pinchot was bothered by the method used in transforming the land. At the time, most forests were being clear-cut, which is when all of the trees are removed at the same time. Pinchot did not like this method because he saw the forest as a valuable resource of timber. He thought that it should be managed in a way that enabled human development of the land but also ensured use of the natural resources. He later founded the organization that would become the U.S. Forest Service and served as chief of the organization while Theodore Roosevelt was president. While Pinchot was in charge, the federal government adopted the conservationist method for managing land and drastically increased the amount of land managed by the government (Education Portal, 2014)."

"The conservation ideal was natural resource management for the greatest good of the greatest number over the long run. The conservation movement emphasized resource development that generated jobs, affordable housing, food, safety, and health. Conservation implies sound biosphere management within given social and economic constraints, producing goods and services for humans without depleting natural ecosystem diversity, and acknowledging the naturally dynamic character of biological systems (University of Colorado, 2000)."

Conservation is the sustainable use and management of natural resources including wildlife, water, air, and earth deposits. The conservation of renewable resources like trees involves that they are not consumed faster than they can be replaced. The conservation of non-renewable resources like fossil fuels involves that sufficient quantities are maintained for future generations to utilize. Conservation of natural resources usually focuses on the needs and interests of human beings, for example the biological, economic, cultural and recreational values such resources have (Encyclopedia of the Atmospheric Environment, 2014).

2.4 Preservation

"The preservationist approach wants to preserve nature in its natural state, untouched by human development. The 1964 Wilderness act describes the larger goal of preservationists: A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain ... (The Wilderness Act, September 3, 1964 quoted after University of Colorado, 2000)."

"The method of preservation is much stricter than the conservationist approach. Under preservation of the environment, lands and their natural resources should not be consumed by humans and should instead be maintained in their pristine form. Preservationists believe that humans can have access to the land, but they should only utilize it for its natural beauty and inspiration. They think that the value of the land is not what you can use from it, but instead that land has an intrinsic value, meaning that it is valuable in itself simply by existing.

One of the most famous preservationists in U.S. history is John Muir. He was a Scottish immigrant who lived from 1838 to 1914 and had a large admiration for California's Yosemite Valley. Similar to Gifford Pinchot, Muir was motivated by the deforestation and destruction of land as the human population moved west across the country. Muir was a strong advocate for the complete protection of land and believed that people should only use the environment for enjoyment and not as a resource for goods.

Muir was involved in the creation of The Sierra Club in 1892, which is an environmental organization that advocates for the preservation and protection of public lands. The influence of John Muir is still evident today through the continuation of The Sierra Club and the establishment of the Muir Woods National Monument, a

preservation area of land in Northern California that is home to an ancient redwood forest (Education Portal, 2014)."

"Preservationists are concerned that mankind is encroaching onto the environment at such a rate that many untamed landscapes are being given over to farming, industry, housing, tourism and other human developments, and that we our losing too much of what is 'natural'. Environmental preservation is often regarded as a deeper form of environmentalism, or eco-centrism. Some preservationists also argue that wildlife and ecosystems should be preserved, whatever the cost, regardless of the economic benefits they may have for humans. This follows from the belief that every living thing has a right to exist (sustainable environment, 2014)." As explained before Eco-centrism (meaning values centered on ecology) and techno-centrism (meaning values centered on technology) are two opposing perspectives concerning attitudes towards human technology and its ability to affect, control and even protect the environment. Eco-centrics, including "deep green" ecologists, see themselves as being subject to nature, rather than in control of it. Techno-centrics, including imperialists, have absolute faith in technology and industry and firmly believe that humans have control over nature. Although techno-centrics may accept that environmental problems do exist, they do not see them as problems to be solved by a reduction in industry (sustainable environment, 2014). This means that both conservationists and preservationists are the parts of the figure 2.11 which presented sustainable development theories. What will be followed in this research is not extreme preservation of radical eco-centric but an idea which floats between Communitarian eco-centric and Accommodating Techno-centric and can in special exceptions spread its limits to preservationists. "Today, most people still believe in the necessity of human progress. Conservationist principles, and the ability of technology to protect nature, should ensure that today's standard of living is maintained in the future, but not at the expense of environmental degradation. Most people today are probably still *shallow environmentalists* (Sustainable environment, 2014)." Thus, as said before the main concepts are derived from eco-centric theories but with an attention to the ability of technology in urban life. The important reality is that in the whole spectrum, the idea of sustainable development and protection of natural resources dominate but the strength of the idea changes from one to the other. This flexibility is required as there are different case studies (regions of Tehran) chosen in chapter 5 which have different characteristics and consequently different approaches have to followed to set the policies in each of them.

"The distinction between the terms "preservation" and "conservation" is somewhat unclear, as the use of these terms along with "restoration", has varied over time, depending partly on the context of their use. Preservation involves keeping a balance between collection-level activities such as environmental control, which can be difficult and/or costly to manage but provide the greatest long-term benefit for the most materials, and item-level activities such as conservation treatment, which are often more easily understood and managed but can have limited effect, especially if the items are returned to a damaging environment (Introduction to preservation, 2006)."

"The two views (conservation and preservation) have been at the center of many historical environmental debates, including the debate over the Hetch Hetchy water project. The Hetch Hetchy Valley is located in the northwest corner of Yosemite National Park, and in the early 1880s, the valley was being considered as a potential site for a reservoir. At the time, the city of San Francisco was growing and faced a shortage of water. With the damming of the river and the creation of a reservoir in the Hetch Hetchy Valley, it would be possible to supply ample drinking water to the people of the San Francisco area. The Hetch Hetchy water project spurred a large debate between preservationists and conservationists. Preservationists, including John Muir, were fighting to keep the Hetch Hetchy Valley pristine and persuade law makers that the valley and its wilderness were valuable in their natural state.

On the other side of the argument were conservationists, led by Gifford Pinchot. They fought to have the river dammed and the valley flooded to create the reservoir so that it could provide a large amount of water to people in areas with limited water. Eventually, the demand for water outweighed the desire for pristine habitat, and the dam was built in the early 1900s (Education Portal, 2014)."

This research is a multidimensional study and comprises ideas from different disciplines. The ecological problem has taken place in an urban environment; the green lands are inside the city and therefore, are not an untouched

part of a nature so far from human being which was addressed by preservationists. Nevertheless, Tehran is situated in a developing country and has a fast urban sprawl and as explained before in the system resilience in figure 2.15, the expansion ball is reaching the threshold point in Tehran which requires swift responses to be set in the form of policies. Hence, it can be stated that in some cases strict policies in the form of preservation may be needed to take back the balance between the departed environment and the human system. The more we get near to the threshold point, the more we shift from techno-centric theories (conservationist) to eco-centric ones (preservationist) and this choice depends on the qualification of the region the research is working on. Chapter 5 describes these qualifications so that it will be easier to choose the suitable approach. Since nowadays in most literature review and projects, the terms preservation and conservation have been used interchangeably, in this study they might be utilized in the same way without taking into consideration the above historical definitions.

2.5 Urban gardens

By the term *green lands* the author states “urban gardens and agricultural lands”; therefore in this part these two terms will be thoroughly clarified and at the end the definition used in the research will be presented. The definition of garden is so wide that a complete research can be allocated to it especially if there is no certain discipline and its meaning has to be presented in all fields of study. Thus, this research tries to focus on a limited number of explanations for garden. Moreover, what is regarded as a “garden” in Iran is different from that in Europe and “urban garden” which is a branch of this category is better perceived in Iran urbanism and ecological science.

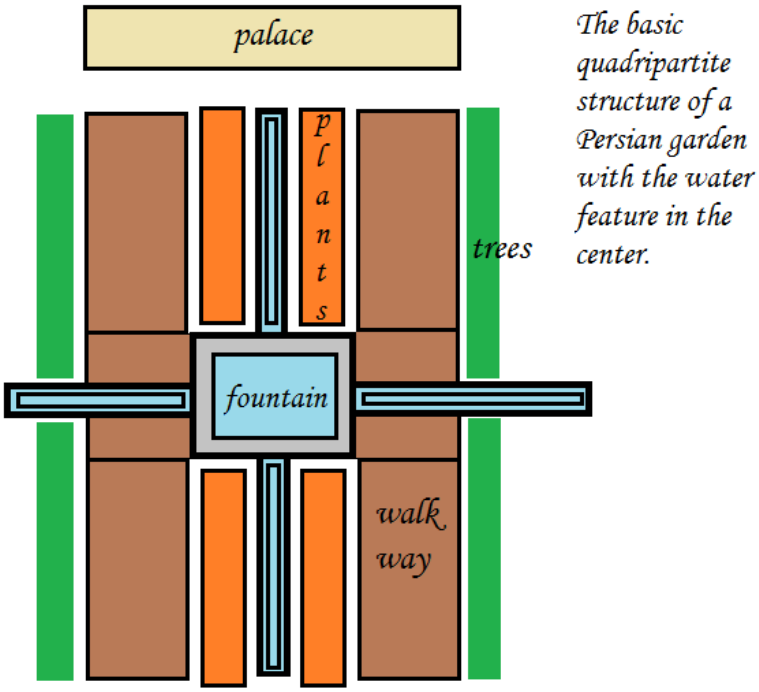
Persian gardens may originate as early as 4000 BC. Decorated pottery of that time displays the typical cross plan of the Persian garden. The outline of the Pasargad Garden, built around 500 BC, is still to be seen today. During the reign of the Sassanids (third to seventh century CE), and under the influence of Zoroastrianism, water in art grew increasingly important. This trend manifested itself in garden design, with greater emphasis on fountains and ponds in gardens.

During the Arab occupation, the aesthetic aspect of the garden increased in importance, overtaking utility. During this time, aesthetic rules that master the garden grew in importance. Chahār Bāgh (Figure 2.16) is an example, a form of garden that attempts to emulate Eden, with four rivers and four quadrants that represent the world. The design sometimes extends one axis longer than the cross-axis, and may feature water channels that run through each of the four gardens and are connected to a central pool (Persian gardens, 2014).

Figure 2.16: Chahar Bagh in Isfahan

Source: Mehr news agency

Figure 2.17: The basic structure of Persian garden



Source: Persian gardens, 2014

The schematic diagram of a Persian garden (Figure 2.17) shows the quadripartite structure with a focal water feature, connecting aqueducts, and surrounding trees, all oriented towards the palace. Sunlight and its effects were an important factor of structural design in Persian gardens. Textures and shapes were specifically chosen by architects to harness the light. Iran's dry heat makes shade important in gardens, which would be nearly unusable without it. Trees and trellises largely feature as biotic shade; pavilions and walls are also structurally prominent in blocking the sun.

The heat also makes water important, both in the design and maintenance of the garden. Irrigation may be required, and may be provided via a form of underground tunnel called a *qanat*, that transports water from a local aquifer. Well-like structures then connect to the qanat, enabling the drawing of water. Alternatively, an animal-driven
Persian well would draw water to the surface. Such wheel systems also moved water around surface water systems, such as those in the *chahar bāgh* style. Trees were often planted in a ditch called a *juy*, which prevented water evaporation and allowed the water quick access to the tree roots. Figure 2.18 shows four of the famous Persian gardens in Iran.

The definition of garden according to laws, regulations and acts in Iran are presented by different organizations and legislations. The forests Range and Watershed Management Organization has given this definition in its regulations:

In the forest regions, garden is a place which has the following characteristics: the borders of the garden have to be recognized from the curvature; the number of natural self maintaining forest trees in the garden parcel must not exceed 50 m^3 in a hectare; it has to have at least 100 fruit trees in a hectare or 200 trees in the whole parcel.

In the Executive Statement of Article 14 of the Urban Land Act garden is defined as followed: Orchard (fruit garden) or tea garden is a piece of land in which the fruit or tea trees have been planted by people and the number of the trees and their placement is according to the tradition of the region and proportionate the garden floor area. The second type is a wooded garden containing either fruit trees or non-fruit in a land which has six 3-year- old trees in each 100 m^2 of it. By that and by taking the required infrastructure into consideration as well, at least ¾ of the land has to be covered by trees (Omrane Sarzamin Consulting Company, 2001).

According to the latest amendment of the Article 1 of the 1980 “Preserving and Spreading Green Spaces in the Cities” Act, garden is defined with characteristics as followed: the area of a garden parcel must be more than 500 m^2; if there is any building on the parcel, in each 16 m^2 of open space outside the building the parcel must contain at least one tree; if there is no building on the parcel, in each 25 m^2 there has to be one fruit tree or non-fruit tree or a combination of both; having garden deed; having the positive vote to confirm the garden in the Commission Code 12 of Urban Land Act; a garden must contain fruit and non-fruit trees and according to Iran law, a tree must have at least 15 centimeters perimeter.

Following these regulations ends up to neglecting large amount of green lands which are environmentally valuable but not legally qualified as gardens. The consequence of this procedure is the destruction of the gardens and logging off trees without any legal punishment. In the current research the author intends to give value to any

existing green space in the city as it is a difficult process to create green spaces in a compact, dense city like Tehran. As a result the area limitation ($500\mathrm{m}^2$) specified in the Iranian code which could not prevent small villa – gardens in the north of Tehran from being used as building lands for apartment blocks, will not be taken into account. The base of garden recognition is more in the direction of environmentalists and according to land cover; this means that aerial photos with the highest available resolution in chapter 5 will be the optic tool to categorize gardens and agricultural lands. More legal explanations regarding gardens, their characteristics, their preservation codes are given in chapter 4.5.

Figure 2.18: Famous Persian gardens in Iran

Source: Eram garden in Shiraz

Source: http://www.azadtarin.com

Shazdeh Garden in Kerman

Source: www.jamejamonline.ir

Golestan Palace in Tehran

Source: http://www.panoramio.com

Fin Garden in Kashan

Source: http://www.persianaks.com

The term “urban gardens” used in this study cannot be compared with the meaning of garden in European literature and is not the exact Persian garden explained above. However, it can have the aesthetical characteristics and elements of the Persian garden. It encompasses often the villa parcels in the north of Tehran (Shemiran) which were left from the time this region used to be the summer residence of the Qajar and Pahlavi Shahs and their relatives who built several palace complexes and villas in the area. Some examples are the Sa'dabad Palace Complex and the Niavaran Palace Complex. Shemiran lies on the slopes of Alborz Mountain and enjoys a suitable mild climate and is a history book which shows us the life style and the culture of our past. It has fine and well-kept parks and is home to the richest class of Iranian society. It still has some of the old villas or garden houses. Gardens like these are called *urban gardens* in this study. Most of these parcels are orchards with a building of valuable architecture in the middle. Many of them have been left abundant and need renovation to live in and some others have just an old construction without any special archeological value but a huge amount of old local Platanus or walnut trees with high ecological value. They do not have just residential land

use, as nowadays many embassies, schools, cultural centers, restaurants and even parking lots have been located in these green parcels. Therefore, the ownership can be private or non- private. In chapter 5, by using GIS the exact urban garden parcels will be derived from aerial photos from 1955 up to present and the urban texture of Shemiran and the land cover of gardens/ agricultural lands will better be shown and perceived.

2.6 Agricultural Land or farmland

Agricultural land is a land devoted to agriculture, i.e. the systematic and controlled use of other forms of life—particularly the rearing of livestock and production of crops—to produce food for humans. It is thus generally synonymous with *farmland* or *cropland*.

The United Nations Food and Agriculture Organization (FAO) and others following its definitions, however, also use agricultural land or agricultural area as a term of art, where it means the collection of:

- "arable land": here, redefined to describe land producing crops requiring annual replanting or fallow land or pasture used for such crops within any five year period
- "permanent cropland": land producing crops which do not require annual replanting
- permanent pastures: natural or artificial grasslands and shrub lands able to be used for grazing livestock (Wikipedia, agricultural lands, 2014).

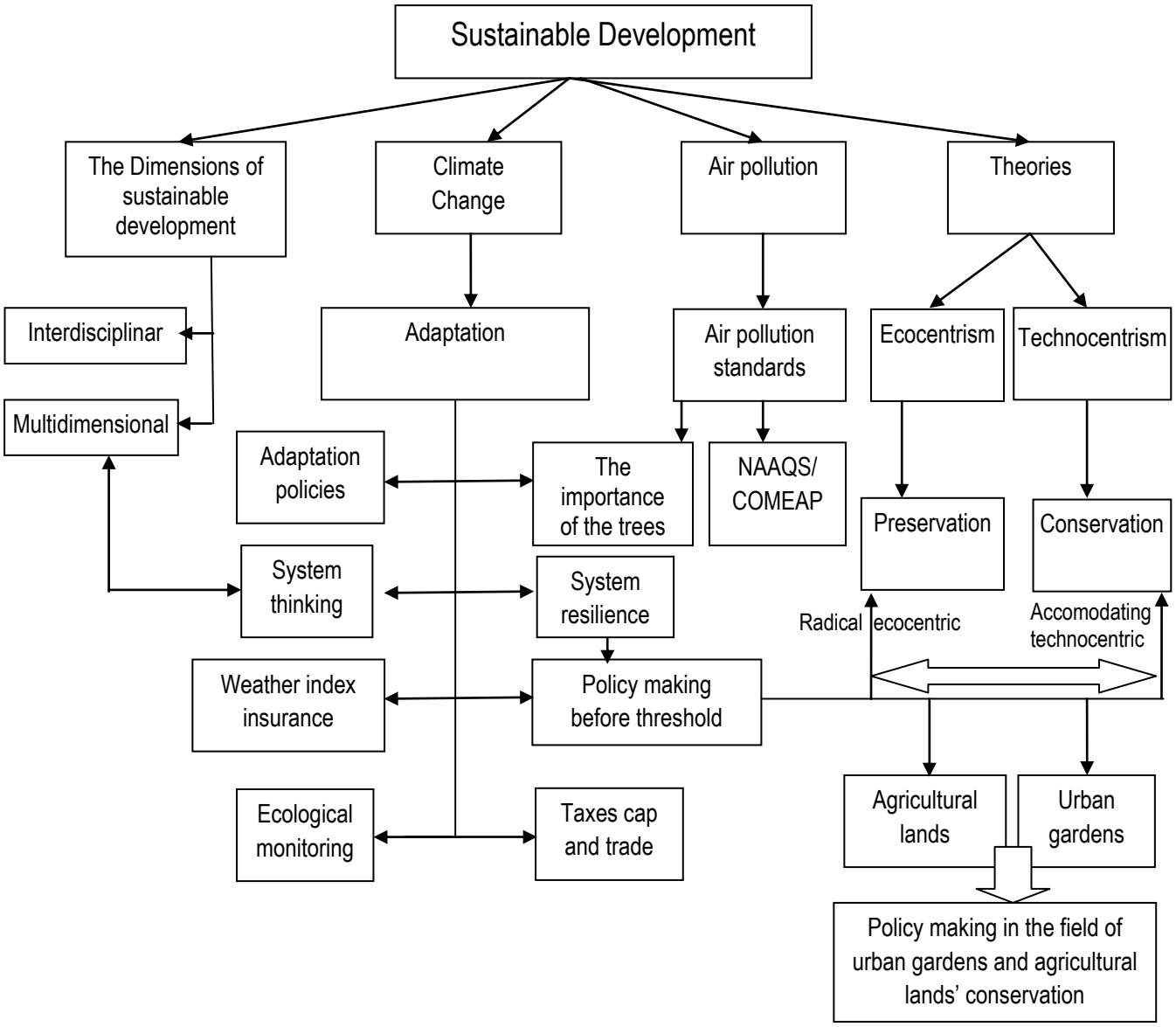
In Iran law, the meaning of farmland/ agricultural land is very important, since there are different interpretations of this term and in reality there are various types of lands depending on the type of climate in this region. As a consequence of water shortage for agricultural usage and the warm weather in most parts of Iran, the productivity of the land and its soil plays an important role in categorizing the land as a farmland. In *Executive Statement of Urban Land Act in 1987*, urban lands are defined as the lands in the legal boundary of the city and are categorized in 3 types; “undeveloped or virgin (mavat) land; abandoned, or unutilized (bayer) land; and, cultivated or developed (dayer) land (Taleqani, 1965/1983 quoted after Keivani, 2008, p.1832).” Undeveloped lands have never experienced any cultivation or plantation but abandoned lands have had a history of cultivation but have been left aside and abandoned. The meaning of agricultural lands is within the third group which comprises cultivated land or cropland as explained above. In the content of the act it is stated that these lands are currently being cultivated by the owner and encompass agricultural lands or fallow lands[1] whether they are confined or not. “The principle is that the ultimate ownership of land belongs to God and only people’s work on land implies private ownership rights. Therefore the state could rightly acquire undeveloped (mavat) land for redistribution purposes without compensation (Keivani, 2008, p.1832).” Thus the terms agricultural land, farmland or cropland might be used interchangeably in the research by referring to the above meaning of crop land in the Iran Urban Land Act.

2.7 Theoretical Framework

By combining the different concepts, theories and definitions the ecological theoretical framework can be presented as in figure 2.19. In the next part this framework will be completed by other aspects. The main framework of this research is based on the two explained theories, the dimensions of sustainable development, air pollution standards and climate change debates. By choosing sustainable development as the research core the interdisciplinary-multidimensional character of the study will be stabilized. Since these two have interrelationship with system thinking, they are connected to the debates regarding climate change as well. Simultaneously, the mentioned debates are associated with air pollution standards and the theories from which the “conservation” and “preservation” definitions stem from. This study has chosen the middle point on the spectrum between conservation and preservation. Policy making has to be before the whole system reaches the threshold point and policies stick the whole elements of figure 2.19 together. In better words the success of the study depends on the reliability, accuracy and feasibility of the policies.

[1] Fallow Land is a cultivated land that is allowed to lie idle during the growing season

Figure 2.19: Theoretical framework (Part 1-ecological)



Source: The author

2.8 The complexity of spatial, socio-economic, ecological and cultural issues

David Harvey (1973) states that a general tenet of location theory and spatial interaction theory is that the local price of a resource or proximity is a function of its accessibility and proximity to the user. Therefore, the changing spatial form of the city and the continuous process of run-down, renewal and creation of recourses within it, will affect the distribution of incomes and may form a major mechanism for the redistribution of real incomes. He then gives an example of the demand for open space in the city, i.e. that its price is low if it is accessible and high if it is not. Thus, the allocation of open space will affect the distribution of income. Moreover, Clawson (1969) says that any use of rural open space, relatively close to the city, as a substitute for or supplement to open space within the city has unfortunate effects in terms of income class participation since these uses of rural open space are limited to the middle and upper income levels. He believes that if the lack of open space has to be responded by the authorities, it has to be in the most urgently needed places of the city centers (Clawson, 1969, p.170 quoted after Harvey, 1973, p.70).

This fact applies exactly in Tehran; one of the main reasons for many people immigrating to the north of Tehran was the accessibility to the gardens, rivers, nice views and the high topography. These ecological reasons made a socio-economic change inside the society, and consequently with the upper-class moving to the north, the land prices increased dramatically. There is a cause- result circle of economy, ecology and sociology.

Harvey introduces two main theories of land use change which have been imposed by the absolute space constraint in the cities. “Filter down” and “blow out”. Everyone strives to procure a better housing in a better location but because of the access to more resources rich people can easily move and leave good quality housing to the others. By such a filtering process the poorest groups eventually achieve better housing. However, they cannot afford the new housing. Yet they have a singular power as richer groups do not easily agree to live in close geographical proximity to them. “The poor therefore exert a social pressure which can vary in its form from a mere felt presence, through a gross exhibition of all those social pathologies associated with poverty, to a fully fledged riot (Harvey, 1973, p.172).” This helps them open up a housing market marvelously. In the “blow out” theory the social and physical pressure is exerted at the bottom end of the housing market and this is transmitted up the socio-economic scale until the richest are forced to move. But the richest of all do not move unless they intend to, which leave the various intermediate groups squeezed between a social pressure emanating from below and an immovable political and economic force from above. Depending upon the pressure different groups may blow out: middle-income groups may be forced to new suburban locations and this may diminish their consumers’ surplus. In practice, the dynamics of the housing market can best be viewed as a combination of filter down and blow out (Harvey, 1973, p.172-173).

This combination can be observed in Tehran. When a layer of new-rich formed after the revolution and because of the misuse of the unsuitable, unorganized and unplanned economic situation at the time of the war and afterwards this social level became stronger and they entered the “filter down” process as explained by Harvey. They left their locations in the center or south of Tehran and could no more live in the geographical proximity to their old neighbors. Thus, they gave more space to the poor to substitute their places. Many farmers in the city boundaries replace their apartments. However, in contrary to Harvey the moving class of Tehran was not rich from the beginning; therefore, their houses were rather affordable for the poor to middle-class neighbors or the suburban residents. The new rich class decided to live in the north of Tehran because that symbolizes money, high social class, wealth and comfort. However, at this point the filter down process shows its face in another form; the local residents could not easily accept these new people but since their houses were their dignity and identity, they could not change their location either. There was no better location for them. Nevertheless, some of them moved to a posh suburb in north-east of Tehran- called Lavasan- 20 km away from their previous location. Since then the blow out theory came into practice in Tehran. A part of the middle-upper class moved to Lavasan but still the new rich and a considerable part of local northern residents did not want to move. They were all immovable layers as Harvey says and as a consequence, a social pressure stemming from the below level (locals) and upper (politicians or new- rich) start squeezing the entire social layers in northern of Tehran. Many new high rises and posh apartments had to be built to locate the overwhelming movements and immigrations to the north, while the ecological and physical capacity of the region has almost come to an end. As a result, there was only one kind of infill development which could respond the rapid change and give more space for the increasing demands: cutting down the trees and destructing the gardens to open some space for denser settlements. The constructions have been so fast and unplanned that the northern regions faced afterwards a period of time with a huge number of vacant apartments which could no more be occupied.

The question here, of course, is the speed with which different parts of an urban system can adjust to the changes occurring within them. Different parts of the urban system have different capacities for adjustment. This is therefore misleading to think of adjustment in the urban system as a homogeneous process proceeding at a uniform rate. In most cases the class which Harvey calls “the better educated and more affluent groups” and that can be observed as the “new-rich in Tehran” take advantage of this time lag to foster their own interests and enhance their own income. The allocation of resources then takes place as an adjustment to this new income distribution and a cumulative process of increasingly unequally distributed income was triggered. Certain groups, particularly those with financial resources are able to adapt far more rapidly to change in the urban system, and

these differential abilities to respond to change are a major source in generating inequalities (Harvey, 1969, p.56). This was the story that combined the destruction of gardens and building constructions with taking advantages of the socio-economic situation of Tehran. The movement theories explained above bring about the construction industry in region 1 in the north, and as the country has not a considerable national production, this became a good resource for making money. The people who moved to the north mostly built up their own apartments or entered the construction business. This procedure widens the gap between the social groups and introduces the new social layers to the society. This is the reason why despite the ecological base, social studies are required in this research. “Forecasting the future of an urban system requires a thorough understanding of the processes generating change and realistic evaluation of the direction in which the social system as a whole is being moved by those processes (Harvey, 1969, p.94).“

Cultural values are affected by the opportunities created in the city environment. Cultures evolve partly by “a specialized patterning of the individual stimulus situation, and a special patterning of the response that could be made to it (Smith et al., 1956, p.25 quoted after Harvey, 1969, p.83). So we may anticipate a cultural evolution within the city system by the reorganization of the physical and social stimuli which exist within (Harvey, 1969, p.83).

On the other hand, ecological values can emanate from cultural values as well. Ecological variations and their associated impacts (resource wars, environmental injustice, and differential effects of environmental degradation) have also become far more salient in the quest for an adequate quality of life. In this regard, too there is no level playing-field upon which class struggle can be evenly played out. This is due to the fact that the relation to nature is itself a cultural determination that can have implications for how any alternative to capitalism can be constructed at the same time as it provides a basis for a radical critique of the purely utilitarian and instrumental attitudes embedded in capitalist accumulation and exploitation of the natural world (Harvey, 2001, p.388). If Tehran residents/authorities had given a higher value and priority to their natural environment, this cultural value would have been reflected in the built environment. The image of Tehran is the image of Tehranian values, cultures and inspirations which does not adore the natural environment but the posh modern urban life which destroys everything that prohibits its expansion. If there were higher ecological values, higher economic values could have been allocated to the parcels with green characteristics. They could have won in the economic competition on housing market and their trees could have been preserved by the green mentality in the residents’ culture. Nevertheless, Tehran residents mostly prefer a classy, deluxe and elegant shopping mall than a preserved green cultural park.

All societies develop means to evaluate, appreciate, represent and live within their surrounding environments (both natural and human-made). Local knowledge concerning the uses of various processes and things, the appreciation of the qualities of local fauna and flora, of changing meteorological and climatic conditions, of soil types, of natural hazards, the construction of symbolic meanings and the development of capacities to represent and read the landscape and its signs effectively- these sorts of knowledge have been fundamental to human survival since time immemorial. The nature of such knowledge vary greatly, depending upon technologies, social forms, beliefs and cultural practices all of which instantiate a certain view of the relationship of human life to life and nature in general (Harvey, 2001, p.226-227).

Engels describes the relation between human and nature in nice statements: ”Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us.” He continues that the first results of the victory are expected whereas the rest are unforeseen effects and this reminds us that we by no means rule over nature, but belong to nature; therefore we should learn its laws and apply them correctly. This statement has been submitted by Herbert Marcuse one of the most influential members in the so-called Frankfurt School of social scientists who further argued that the domination of nature inevitably entails the domination of other human beings and even of human nature itself (Harvey, 2009, p.218-219). This is exactly the point missing in Tehran which is the fine layer between ecology and culture and can be called “ecological culture” or ”eco-culture”. It can be claimed that Tehran residents can hardly consider themselves as a part of nature; otherwise in the most of good offered economic circumstances they could not

have devoted their belongings for money. However, in a hard economic situation this can probably sound a bit unrealistic but on a lower level the respect to nature is not on their first or second priorities either. The mentalities are mostly based on exchanging ecology and trees for money and this kind of mentality can easily lead to the destruction of nature for the sake of economy and urban development. Thus, looking at the research problem just from economic point of view will not exactly cover all aspects of the issue and cannot thoroughly improve the current situation. People mentality and as a consequence their culture forms the city in many cases more effective by than their economic status.

As another form of mentality which often emanates from the lack of information people consider that high carbon mobile lives and the climate change consequences only pertain to the super-rich and are without wider economic, social and carbon significance. But this is not the case since we are all implicated in such a high carbon excess (Urry, 2011, p.76). When nature is destructed, climate change affects all cities and countries of the world; however, it is mostly caused by few numbers of countries or cities. To make it clear in the case of Tehran, when the green lands have not been preserved and trees have been chopped off every year for the sake of urban development, the nature has lost the balance between built and green environment and sooner or later the resulting negative consequences impact everyone concluding the ones far away from Tehran. Thus, this issue is global and does not belong to certain boundaries or countries and can be solved only by a global approach.

The evolution of the urban system can lead to large scale sensory deprivation in terms of clean air and overexposure to others such as suburban vistas, air pollution and etc. In the long term, therefore, we must evaluate decisions about the growth of the city against a set of overriding cultural values which we wish to be preserved or augmented; otherwise, we may see the emergence of new sets of cultural values and, if present trends are anything to go by, these may lead to violent conflicts and, perhaps, to an ultimate social self-destruction. The sensibilities of mankind cannot remain permanently immune to the environmental changes man is bringing about through his own actions (Harvey, 1969, p.85). Since the spatial form of the city should presumably facilitate the coherent functioning of social processes, the expansion of Tehran without a proper plan can be observed from this point of view as well. This physical sprawl without enough surveillance for years caused the new cultural values and the new social layers explained above. The chaotic combination of cultures, values, social issues and economic problems stem all from the unorganized rapid expansion of the city without any suitable management. Hence, the current complications can start to get regulated only if all these aspects in one package can be taken into consideration.

Another fact which has to be mentioned is the characteristics of the capitalist society in which owners posses monopoly privileges over prices of the space (Marx, Capital volume 3, p.616). Landed property is based on the monopoly by certain persons over definite portions of the globe, as exclusive spheres of their private will to the exclusion of others. Landowners thus possess a class monopoly over land use (Harvey, 1969, p.178-179). “Monopoly rent arises because social actors can realize an enhanced income-stream over an extended time by virtue of their exclusive control over some tradable item which is in some crucial respects unique and non-replicable (Harvey, 2001, p.395).” This happened in Tehran when the new rich developers start building up the posh high-rises in previous garden parcels and with a poor governmental control on the prices, they claimed very high rents or sales which were not comparable to the other regions. The relating statistics can be found in chapter 5 and 3. There was a time that this monopoly was very hard for the government to be broken and the real prices have been hidden for a long time. This procedure makes the living conditions for the local harder than before and was a stimulus for them to move which itself caused a “blow out” cycle in region 1 again. Gradually the local educated upper class shifted to middle-upper class which could not easily afford all the inflations and new economic circumstances in their own neighborhood. All the above discussions open up the debate of “Social justice” which will be defined below.

There are two situations in which the category of monopoly rent comes to the fore. The first arises because social actors (which have been called “speculators- developers”) control some special quality resource, commodity or location which enables them to extract monopoly rents from those desiring to use it. These values are so high that the long distance of the region to the center and main business district does not play a big role in devaluating

the uniqueness. These are the indirect cases of a monopoly rent. It is not the land, resource or location of unique qualities which is traded but the commodity of service produced through their use such as transport network for a hotel chain. In the second case, the land or resource is directly traded upon. Scarcity can be created by withholding the land or resource from current uses and speculating on future values. Monopoly rent of this sort can be extended to ownership of works of art such as Picasso. However the two forms usually intersect (Harvey, 2001, p. 395-396).

The mentioned special uniqueness is the main base of the market in region 1 of Tehran. The developers claim that the offered price is because of the location. The locational aspect in Harvey's idea is centrality which is not in the case of Tehran region 1. The unique characteristics of this region are included in the term 'location'. The proximity to the mountains, good weather and high life standards are some examples which do not exactly have the physical meaning of location and land. These will be explained in chapter 3 (quality of life in Tehran regions) and 5 (the unique characteristics of region 1). Nevertheless, recently this region has formed new commercial centers with outer-regional scale function and strengthened the previous local market to overcome this deficiency.

There are two contradictions in the monopoly rent. First, while uniqueness and particularity are crucial to the definition of "special qualities", the requirement of tradability means that no item can be so unique or so special as to be entirely outside the monetary calculus. The other one is that the more easily marketable an item becomes the less unique and special it appears. In some instances, the marketing itself tends to destroy the unique qualities (Harvey, 2001, p. 396). This is the challenge that is now occurring in the land market of the regions with green spaces in Tehran, especially region 1 with its special qualities. That is the reason that the exact and clear price of land and apartment cannot be easily estimated and confirmed by different social players. If the prices become marketable, region 1 will no more be as unique as it is now.

2.9 Speculator-developers

The realization of a class-monopoly rent depends on the existence of a class of speculator-developers[1] who have the power to capture it. In a free market economy, speculator-developers perform a positive service. They promote an optimal timing of land use change, ensure that the current value of land and housing reflects expected future returns, seek to organize externalities to enhance the value of their existing developments, and generally perform a coordinating and stabilizing function in the face of considerable market uncertainty (Neutze, 1968; Hall et al., 1973 quoted after Harvey, 1985, p.68).

The role of speculator- developer is, in fact, integral and essential to a capitalist economy. Since the urbanization process relates to economic growth in general, the speculator-developer, who is, in effect, the promoter of urbanization, plays a vital role in promoting economic growth. Certain institutional supports are necessary, however, if this role is to be performed effectively. The exact nature of these supports will vary from country to country but they must do two things: (1) they must reduce the uncertainty in land use competition, usually through some form of governmental regulation-planning or zoning control, provision of infrastructure, etc., and (2) they must encourage wealthy groups- those who can afford to wait for land to "ripen"- to participate as speculator-developers, usually by offering convenient and advantageous tax arrangements. The first support permits speculator-developers to form reasonable expectations about the future, while the second ensures that only people with sufficient resources undertake the task of coordinating and stabilizing land-use change (Harvey, 1985, p.68)."

Harvey has given a nice positive role to the speculator-developer group whereas this group can also function negatively in the housing market with economic complexities and over-accumulation. In the case of Tehran with a poor surveillance on the developments and a substantial part of people in this group that are unsuitable for this development, their activities are not on the right track as Harvey explained. They do make uncertainty in the land use competition and they often do not interfere in tax arrangements and regulation planning. Their increasing

[1] The term "speculator-developer" is used to refer to all those individuals and institutions that operate in the land and property markets with a view to realizing gains through ultimate sale or change in land use.

power is threatening to the government, economic situation and the housing market. Thus, in order to improve real estate market and consequently economic status of the city, speculators-developers' activities have to be regulated more according to written codes and rules.

2.10 Social justice

"The concept of social justice is not an all-inclusive one in which we encapsulate our vision of the good society. It is rather more limited. Justice is essentially to be thought of as a principle for resolving conflicting claims. These conflicts may arise in many ways. Social justice is a particular application of just principles to conflicts which arise out of the necessity for social cooperation in seeking individual advancement (Harvey, 1969, p.97).

Applied to geographical situations Harvey's principles of social justice can be summarized by three points; the first one is that the spatial organization and the pattern of regional investment should be as such that they fulfill the needs of the population. With the unplanned rapid Tehran growth explained above, this could not be realized in Tehran urban planning. Although urban plans existed at that time, they have barely been executed and followed by the authorities. Therefore, the spatial organization of the city found its way mostly on its own and according to the stakeholders', developers', affluent', new rich people's and politicians' pressures.

The second principle is that "a special organization and pattern of territorial resource allocation which provides extra benefits in the form of need fulfillment and aggregate output in other territories through spillover effects[1] and multiplier effects is a better form of spatial organization and allocation." Whereas the third states: "deviations in the pattern of territorial investment maybe tolerated if they are designed to overcome specific environmental difficulties which would otherwise prevent the evolution of a system which would meet or contribute to the common good (Harvey, 1969, p.107-108)."

Note that the increasing accumulation of wealth at one pole and the formation of a penurious rabble trapped in the depths of misery and despair at the other (which is a typical symbol of social injustice) sets the stage for social instability and class war that cannot be cured by any internal transformation such as redistribution of wealth from rich to poor (Harvey, 2001, p.371). Hegel as well rejects the idea that there might be ways to solve the problem of social inequality and instability through internal mechanisms of redistribution (Harvey, 2003, p.125).

As it has been mentioned in the first part of this chapter, climate change comes along with social justice and inequity debates."Achieving participation across all countries, both developed and developing, is challenging because of the fundamental inequality in the impacts of climate change: rich countries very largely caused the climate change problem, while developing countries will feel the effects first and have less capacity to adapt. This inequality is inextricably linked to both effectiveness and efficiency. Without strong action in developing countries, especially in India and china, their emission are likely to grow strongly over the coming decades and account for increasing shares of the global total. Therefore, without developing country participation in a global deal, the world will not be able to achieve emission on the scale at the speed required, and costs of action will rise. As a result, if the world is to have any chance of securing the global deal that is effective and efficient, it must first address the fundamental injustice in climate change. Technology transfer and measurement, reporting and verification (MRV) of emissions are also key area where progress must be accelerated. Progress is now in the hands of rich countries. They have a unique opportunity to address the inequality in climate change, restore the trust of developing countries and drive a strong deal forward (Held, 2011, p.82-83)." The developing countries need not just hard-wares or technologies but also soft-wares and mentalities which have been called eco-culture above. They might not have had a big share is causing climate change but they likely will have a huge influence on the future of the climate change and make it worse than developed countries. Thus, investing time, technology, knowledge and money on such projects will be efficient for the whole globe.

[1] In economics, spillover effects are economic events in one context that occur because of something else in a seemingly unrelated context.

The most important aspect of climate politics is perhaps idealism. Even after we have done all we can to build public support, institutionalized intergenerational equity and spoken to people's self-interest, there will still be work to do. It is in that space, after the work of self-interest is done, that we cannot live without ideals. We need a politics of climate change that speaks to people's idealism as well as their wallets and the most important ideal is social justice. We do not just need to preserve our world for future generations; we need to hand over a fairer world. We need to show people how action on climate change can reduce inequality and build up a stronger, more cohesive society. That includes energy bills, keeping costs down, ensuring fair access to new jobs and opportunities. But it is also something bigger; we are a transition economy and it is at moments of transition that we have the greatest ability to shape society for the better. The central challenge is to incorporate climate change into everything we do: so it is an intrinsic part of our economic policy, our energy policy, our approach to social justice (Held, 2011, p.201).

The term 'social justice' and 'sustainability' are both highly indeterminate; however, if we aim both for social justice and sustainability, we shall need to aim not merely for a configuration of each that is internally coherent, but for a configuration of the both that is coherent (Held, 2011, p.139). This statement is the main linkage between the first part of the theoretical basis on environmental theories and the second one regarding capital accumulation and social justice.

2.11 Built environment

Each of the global crises of the capitalism was in fact preceded by the massive movement of capital into long-term investment in the built environment as kind of last-ditch hope for finding productive uses for rapidly over-accumulating capital. The extraordinary property boom in many advanced capitalist countries from 1969 to 1973, the collapse of which at the end of 1973 triggered the onset of the current crisis, is a splendid example. The flow of investment into the built environment depends upon the existence of surpluses of capital and labor and upon mechanisms for pooling the former and putting it to use. This history of this process is extremely interesting when in the eighteenth century in Britain was characterized, for example, by a capital surplus, much of which went into the built environment because it had nowhere else to go. Investments in the built environment took place primarily for financial rather than use-value reasons-investors were looking for a steady and secure rate of return on their capital (Harvey, 1985, p.20 and 22). With this explanation by Harvey the situation in Tehran can be better perceived. Here, the sanction and political problems do not let the country open its doors for trade and business; therefore, the petrol money does not have any other opportunity to be invested than building industry. Moreover, financial profit alongside with poor surveillance gets so important that land speculation cannot be separated from this industry.

"Capitalist development has therefore to negotiate to a knife-edge path between preserving the exchange values of past capital investments in the built environment and destroying the value of these investments in order to open up fresh room for accumulation. Under capitalism there is, then, a perpetual struggle in which capital builds a physical landscape appropriate to its own condition at a particular moment in time. The temporal and geographical ebb and flow of investment in the built environment can be understood only in terms of such a process. The effects of the internal contradictions of capitalism, when projected into the specific context of fixed and immobile investment in the built environment, are thus writ large in the historical geography of the landscape that results (Harvey, 1985, p.25)." In other words, "capitalism perpetually strives, therefore, to create a social and physical landscape in its own image and requisite to its own needs at a particular point in time, only just as certainly to undermine, disrupt and even destroy that landscape at a later point in time. The inner contradictions of capitalism are expressed through the restless formation and re-formation of geographical landscapes" (Harvey, 2001, p.333). Unfortunately, geographical landscape is the victim of these value transformations in capitalism and in the case of Tehran this has been conducted by the built environment. The posh high-rises which are now the big image of capitalism in Tehran may be substituted in the future by a new life style. This happened in the past as well; when the garden-villas lost their socio-cultural values for the settlements of the wealthy, affluent residents and were replaced by high-rises. The result was the destruction of geographical landscape (gardens and villas) to

reform and adjust it to the new values by the means of the built environment (high-rises) which had been influenced by modernism.

The reproduction of both capital and labor power requires a wide range of physical and social infrastructures. These consolidate and reinforce the trend toward structured coherence within an urban labor market. Some of these infrastructures are embedded in the land as a built environment of roads, bridges, sewers, houses, schools and so on. They hang together as a spatially specific resource complex of humanly created assets to support both production (fixed capital) and consumption (the consumption fund). They absorb often large quantities of long-term and geographically immobile capital investment and require further capital during their lifetime to compensate for wear and tear and maintenance needs. The stock of fixed capital and of consumption fund assets does, however, provide a solid form of wealth that can be used to produce and consume more wealth. The urban region acquires another meaning- it can be defined as a particular spatial configuration of a built environment for production, consumption, and exchange (Harvey, 1985, p.145)."

Each form of the geographical mobility of capital requires fixed and secure spatial infrastructures if it is to function effectively. Nowadays, not only well-organized telecommunications is required but, a secure backing system plus an efficient, stable transport system backed by the whole set of social and physical infrastructure (Harvey, 2001, p.331).

"Social infrastructures are harder to pin down. They are not immobile and fixed in space in the same way as built environments (though to the degree they use the latter they also are confined spatially), and they have a variety of orientations (from care of the aged and maintenance of the labor reserve in a state of readiness to enter production, through active policies to enhance labor qualities and ensure discipline and respect for authority, to essential governmental, legal, technical, and scientific services for capitalists (Harvey, 1985, p.145-146)."

"An examination of physical and social infrastructures will help to broaden the conception of what an urban region is all about. It is a living community endowed with certain physical and social assets, themselves the product of a long historical development and class struggle. These assets define the wealth of a community, and it is through their proper maintenance, enhancement, deployment, and use that the productivity of labor power stands to be continuously preserved and enhanced at the same time as the reproduction and expansion of capital is assured. The problem, of course, is that this wealth is produced and sustained through the circulation of capital, which is itself crisis-prone. The viability of the physical and social infrastructures is perpetually threatened by the cold winds of over-accumulation, devaluation, and dissolution (Harvey, 1985, p.147-148)."

The general dynamic of capitalist accumulation, which, from time to time, generates chronic overproduction, surplus, real productive capacity, and idle money capital desperately in need of productive outlets. In such a situation, money is easily come by to produce long-term investments in the built environment, and a vast investment wave flows into the production of the built environment, which serves as a vent for surplus capital and the construction interest is also faced with an extremely difficult pattern of booms and slumps which militates against the creation of a viable long-term organization for the coherent production of the built environment. A structure to the urban problems can be discerned which is explicable in terms of the conflicting requirements of the various classes and factions as they face up to the problems created by the use of the built environment as a vent for surplus capital in a period of over-accumulation (Harvey, 1985, p. 170-171). "The endless accumulation of capital produces periodic crises within the territorial logic because of the need to create a parallel accumulation of political/ military power. When political control shifts within the territorial logic, flows of capital must likewise shift to accommodate (Harvey, 2003, p.183)."

As the house market statistics show in Tehran (see chapters 3, 5 and 6) every couple of years Tehran experiences dramatic slumps after years of booms, and this occurs more extremely in region 1 in the north where the land speculation is an incremental phenomenon. Tehran is probably facing the over-accumulation and according to Harvey the next phases will be devaluation and dissolution. Currently, more than 400,000 residential units are vacant in Tehran[1], and with the new projects in the new cities in the Tehran province this number will go

[1] According to the deputy of Road and Urbanism Organization

up to one million. Thus, this devaluation seems to arise from long-term, overinvestment in the built environment without considering the requirements of the society by exact planning. Here, is where the role of planners' intervention and the characteristic of the successful built environment being planned by them stand out. "The built environment must incorporate the necessary use values to facilitate social reproduction and growth. Its overall efficiency and rationality can be tested and measured in terms of how well it functions in relationship to these tasks (Harvey, 1985, p.171)." There is a general conception of the potential for a harmonious, balanced investment process in the built environment. Any departure from this path will entail either under-investment (and a constraint upon accumulation) or overinvestment (and the devaluation of capital). The problem is to find some way to ensure that such a potentiality for balanced growth is realized under the conditions of a capitalist investment process (Harvey, 1985, p.173).

This can lead to what Harvey identified as "crisis" and explains it as followed: "We can identify three wellsprings out of which crises in capitalist society typically flow. First, an imbalanced outcome of the struggle between the classes or factions of class may permit one class or faction to acquire excessive power and so destabilize the system (well-organized workers can force the wage rate up and the accumulation rate down; finance capital may dominate all other factions of capital and engage in uncontrolled speculative binges, and so forth). Second, accumulation pushes growth beyond the capacity of the sustaining natural resource base at the same time as technological innovation slackens. Third, a tendency toward over-accumulation and overproduction is omnipresent in capitalist societies because individual entrepreneurs, pursuing their own individual self-interest, collectively push the dynamic of aggregative accumulation away from a balanced growth path. The particular role of the built environment in all of this is complex in its details but simple in principle (Harvey, 1985, p.172)." By conducting this study, the three origins of crises mentioned above have to be considered to assess the severity of the current economic crisis in Tehran. However, the following statement of Harvey essentially confirms the existing processes of crisis in this city.

Marx's exclusion of any spatial fix permits him to concentrate attention on the fundamental processes of crisis formation. In the course of crisis, vast quantities of capital are devalued and destroyed, the labors and their labor power suffer a like fate, and capitalists cannibalize and liquidate each other in that 'war of all against all' that is the ultimate hallmark of a capitalist mode of production (Harvey, 2001, p.338).

Investments in the built environment can be coordinated with general social requirements in one way, or in a mix of three:

Allocations can be arrived at through market mechanisms. Elements that can be privately appropriated under the legal relations of private property can be rented and traded. This sets up the price signals which allocate land and plant to the best-paying uses. However, the innumerable externality effects and the importance of public good[1] items that cannot be privately appropriated generate frequent market imperfections so that in no country is investment in the built environment left entirely so competitive market mechanism.

The second way is that allocations may be arrived at under the auspices of some hegemonic controlling interest such as a land or developer monopoly controlling financial interests. Here, a large-scale enterprise coordinating investments of many different types can" internalize the externalities" and thereby make more rational decisions from the investor standpoint. The problem with monopolization and hegemonic control is that the pricing system becomes artificial, while there is nothing to ensure that monopoly power is not abused.

State intervention as the third way is an omnipresent feature in the production, maintenance and management of the built environment. The pervasive externality effects have in all countries led to state regulation of the spatial order to reduce the risks that attach to long-term investment decisions and the public goods elements in the built environment, which cannot feasibly be privately appropriated, have always been created by direct investment on the part of the agencies of the state (Harvey, 1985, p.173-c174). Here, the question arises if gardens or parts of them with special characteristics and higher priorities can be considered as public goods to get state support and

[1] In this context public goods are streets, sidewalks, sewer and drainage system.

a higher guarantee of preservation, or if there is any combination of these three ways which could be appropriate for the green lands in Tehran.

"The exact mix of private market, monopolistic control, and state intervention and provision has varied with time as well as from place to place. Which mix is chosen or, more likely, arrived at by a complex historical process is not that important. What is important is that it should ensure the creation of a built environment that serves the purpose of social reproduction and that it should do so in such a manner that crises are avoided as far as is possible (Harvey, 1985, p.174)."

2.12 Government, urban planner and space-time in geography

The research started from socio-economic complexities in which speculator-developers are active by making the built environment, and then there were the qualifications of a productive built environment which plays a positive role in avoiding crisis have been stated. As has been emphasized that the planner and the state play big roles in such a society, their qualifications and missions/responsibilities have to be explained. "The certain basic functions of the capitalist state can be summarized in three points: help to stabilize an otherwise rather erratic economic and social system by acting as a crisis-manager, strive to create the conditions for "balanced growth" and a smooth process of accumulation, contain civil strife and factional struggles by repression (police power), cooptation (buying off politically or economically), or integration (trying to harmonize the demands of warring classes or factions).

The state can effectively perform all of these functions only if it succeeds in internalizing within its processes the conflicting interests of classes, factions and diverse geographical groups. A state that is entirely controlled by one and only one faction, that can operate only repressively and never through integration or cooptation, will likely be unstable and will likely survive only under conditions that are, in any case, chronically unstable. The social democratic state is one that can internalize diverse conflicting interests and that, by means of the checks and balances it contains, can prevent any one faction or class from seizing direct control of all the instrumentalities of government and putting them to its own direct use. Yet, the social democratic state is still a capitalist state in a sense that it is a capitalist social order that is helping to reproduce. If the instrumentalities of state power are turned against the existing social order, then we see a crisis of the state, the outcome of which will determine whether the social order changes or whether the organization of the state reverts to its basic role of serving societal reproduction (Harvey, 1985, p.175)."

As at the end of the study the above mentioned complexities in Tehran have to be managed by an urban planner in the form of policies, the mission of an urban planner in the society with such issues has to be clear here. "The planner's task is to contribute to the processes of social reproduction and that in so doing the planner is equipped with powers vis-à-vis production, maintenance, and management of the built environment which permit him or her to intervene in order to stabilize, to create the conditions for "balanced growth" to contain civil strife and factional struggles by repression, cooptation or integration. And to fulfill these goals successfully, the planning process as a whole must be relatively open. The history of those who seek to depart radically from this fairly circumscribed path suggests that they either encounter frustration or else give up the role of planner entirely (Harvey, 1985, p.176)."

The linkage between planners' role and social justice is that the planner needs to acquire an understanding of how the built environment works in relationship to social reproduction and how the various facets of competitive, monopolistic, and state production of the built environment relate to each other in the context of often conflicting class and factional requirements. Planners are therefore taught to appreciate how everything relates to everything else in an urban system, to think in terms of costs and benefits and to have some sympathetic understanding of the problems that face the private producers of the built environment, the landlord interest, the urban poor and the managers of financial institutions (Harvey, 1985, p.176). His mission becomes more sensitive when it comes to the configuration of investments and be effective in social justice, as Harvey (1985) notes that the accumulation of planning knowledge arises through incremental understanding of what would be the "best" configuration of

investment, both in spatial and in terms of quantitative balance, to facilitate social production. This is when the planner can manage the crisis and its causes explained above. Moreover, spotting the present and future dangers and heading it off, if possible, an incipient crisis of the built environment are other essential tasks of him. His ideology of social harmony is followed unless it is perverted or corrupted in some way, always puts the planner in the role of "righter of wrongs", "corrector of imbalances" and "defender of the public interest (Harvey, 1985, p.177)."

In addition, "political struggles and arguments may, under the planner's influence, be reduced to technical arguments for which a rational solution can easily be found. Those who do not accept such a solution are then open to attack as unreasonable and irrational (Harvey, 1985, p.177)." Thus, planner has to have multidimensional, systematic way of thinking to plan for the complexity of the built environment market in order to prepare grounds for social justice in the society and prevent crises. He links different elements and has to have diverse knowledge about all the aspects of the city and deal with the different social layers it has. Hence, the only policies which can be successful are the ones who have been made by such as planner, the one who considers all the above explained complexities of the region he plans for.

Moreover, the spatial organization of the city is mostly directed by the city planner. Harvey (2001) states that it is necessary to overcome space and planner's task in the context of capitalism is to construct dynamic representations of how that contradiction is expressed through historical-geographical transformations.

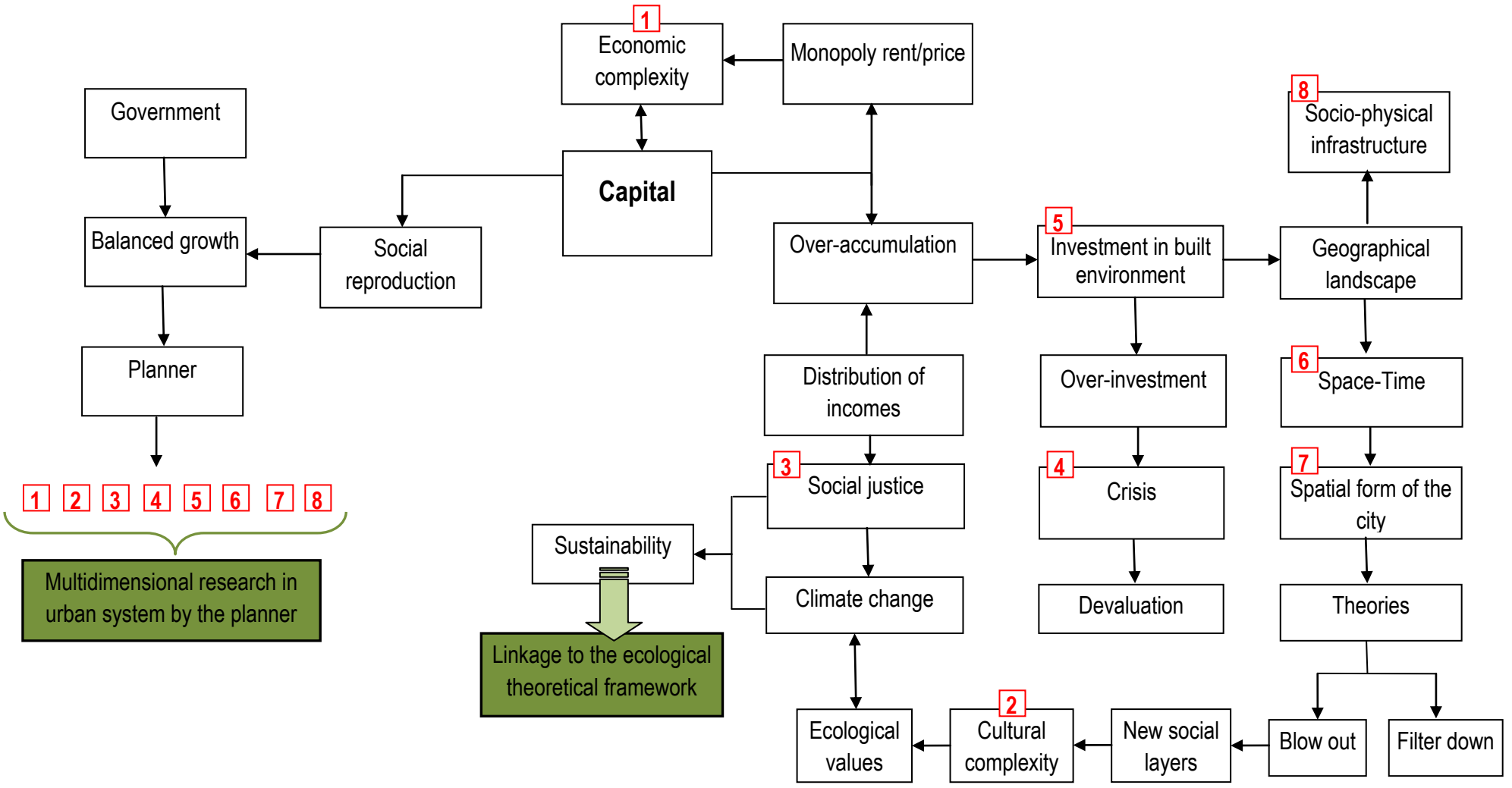
The accumulation of capital has always been a profoundly geographical affair. Without the possibilities inherent in geographical expansion, spatial reorganization and uneven geographical development, capitalism would long ago have ceased to function as a political economic system. This perpetual turning to "a spatial fix" to capitalism's internal contradictions (an over-accumulation of capital within a particular geographical area) coupled with the uneven insertion of different territories and social formations into the capitalist world market has created a global historical geography of capital accumulation whose character needs to be well understood (Harvey, 2001, p.369).

Therefore, in this study a relatively good knowledge of geography is required because as Harvey (2001) notes a general studies in comparative historical and geographical settings are needed to better understand how dialectical relationship between forms of geographical knowledge and socioeconomic and ecological developments occur. Moreover, a better understanding of the links between geographical discourses which emanate from particular institutions and the way geographical knowledge are created both within and without the specific discipline of Geography is crucial to lead these studies. Geography can be the very first layer base of data and science on which other scientific data can be overlaid. Without it, the fundamental ground of the research will not be complete and reliable.

Note that the question of how peoples do and should understand the relationship to environment and nature forms the fourth pillar to all forms of geographical knowledge (Harvey, 2001, p.227). Since the main context of the research emanates from an ecological issue, here, the relevance of setting a geographical base for the whole research becomes clearer.

Alfred North Whitehead in La theorie relationiste de l'Espace claims that the determination of the meaning of nature reduces itself principally to the discussion of the character of time and the character of space. Whereas Harvey says that many of the key terms we use to characterize our world such as city, state, community, ecosystem and region cannot properly be understood without a proper consideration of the character of both time and space (Harvey, 2009, p.133). Space-time or spatio-temporality cannot be separated from each other and are the fundamental ontological categories in our understanding of the world which Geography internalizes within itself the same problematic as other disciplines. This implies that all geography is historical geography no matter where it is to be found. Without spatial ordering/ spatial form which is defined in space-time, geographical knowledge tend to become dead and immovable structures of thought and understanding when their most exciting manifestation invariably comes from observing them or even setting them in motion (Harvey, 2001, p.223). Kant regards a proper knowledge of geography as the proper characterization of space and time and as a necessary precondition as well as the ultimate endpoint of all forms of humanity (Harvey, 2009, p.133).

Figure 2.20: Theoretical framework-part 2 (socio-economy, law and space)



Source: Author

“On the other hand, the circulation and accumulation of capital occurs, in short, in the first instance in a relative space-time that is itself perpetually subject to change through the ability to move in space-time. But this is the world of a posteriori valuations, of speculative ventures, and the anarchy of market coordinations (Harvey, 2009, p.149).” Hence, in this study with a geographical aspect and the strong emphasis on the necessity of geography as the base for other layers of data on one side and capital accumulation in economic debates on the other side, space-time procedure has been followed in chapter 5 to review the qualifications of the green lands during the time in different regions of Tehran and to choose the best appropriate case studies for this research. Without comparative study which can be conducted in the form of spatio-temporality the current green status of Tehran cannot be evaluated and the necessity of the research cannot be proved.

In addition to geographical knowledge, a planner who works on a society with these complications has to perceive deeply all the aspects of the economic market to overcome the problems with the recommended spatial organization. In fact, since urbanization has accelerated to create a major ecological, political, economic, cultural and social revolution in the spatial organization of the world’s population, the urban planner has to be aware of all these sciences to organize the urbanization. He has to be able to configure the environmental with the economic, the political with the cultural which Harvey (2001) says is not easy where the presumption of homogeneity of values and aspirations in larger scales simply does not hold. The elements of this part of the theoretical basis can be summarized as the second part of the theoretical framework (Figure 2.20) which completes the first one. As shown in the figure, “sustainability” is the linkage between the frameworks. Planners’ multidimensional tasks have been highlighted in the figure as well.

3 Tehran Characteristics

3.1 Historical geography

Geographically[1], Tehran has a special position. Located at the southern slopes of the Alborz Mountains, it has relatively rich resources of water and a mild climate. Considering its geographical situation and its potential for population settlement, Tehran is centrally located which gives it the easy access to all parts of the country. Today, however, Tehran faces various bio-environmental problems such as pollutions, as there is an excessive pressure on the resources of the city, the environmental limitations of which are at stake.

In 617, Yaghoot Homavi writes: "Tehran is one of the villages of Rey, with an approximate distance of 6 kilometers. The village is very big and is built underground. No one can gain access to the houses of the villagers except the people of Tehran themselves. The village has 12 neighborhoods and many orchards and prayer halls." After Mostofi, Muslim geographers repeated what he had written about Tehran. Don Ruy Gonzáles de Clavijo, a Castilian ambassador at the time of Timurids, is probably the first European to visit Tehran in 1404, and refers to it as a city, "unwalled, with many orchards and gardens." In 961, king Tahmasb of the Safavid dynasty built a wall around the city which indicates that until then the city has been something like the a fortress, protected from invasions by its underground houses.

In Agha Mohammad Khan's age (1822) Tehran has been selected as Iran's capital (Habibi and Hurcade, 2005). In the first map of Tehran by the French Mesu Kershish the city had 6 gateways, 4 quarters and 100000 people surrounded by a wall. In this time, Tehran had an area of 4 square kilometers 1/3 of which devoted to residential fabrics and 2/3 devoted to farming and gardening (Mehdizadeh, 2003). In 1921, the population was 210000, in a city area of 7.2 square kilometers. The physical growth of the city was still slow and Tehran was relatively compact, with the high population density of 291 persons per hectare. Since the 1920s the physical and population growth of the city accelerated due to the various reasons. In the first official census (1956) the population had reached 1510000 persons and the city area also had been enlarged to 100 km^2 (Iranian Statistics Center, 1986). This rapid growth continued with greater intensity in the following decades. Due to the rapid growth, a council for the supervising the expansion of Tehran, including 10 ministers and 3 department managers, has been established under the supervision of the acting prime minister to control and prevent irregular expansion and make a plan for its future based on the act dated 1973. However, in practice this council failed to control the growth. In 1980, the Tehran municipality was forced to expand the scope of its services, changing legal expansions from 225 to 520 km^2, and also increase the number of municipal districts from 12 to 20 (Mashhadizadeh Dehaghani, 2002). By that year, more than 120 villages and 2 cities had been absorbed by Tehran. The process of rapid growth has been repeated in the next periods. In the latest official national census (2006), Tehran had a population of 7900000 and extended even more than 800 km^2. For the last 85 years, the population of this city has multiplied by 37, while in the same period its area has been increased by 100. The population density of the city in all periods, except for the recent period, presents a descending trend from 291 in 1921 to 95 persons per hectare in 2006 (Table 3.1). Disregarding rapid physical growth as such shown in figures 3.1 and 3.3, the city expansion has been unplanned, desultory and dispersed which are the typical characteristics of sprawl (Roshan et al., 2010, p.45).

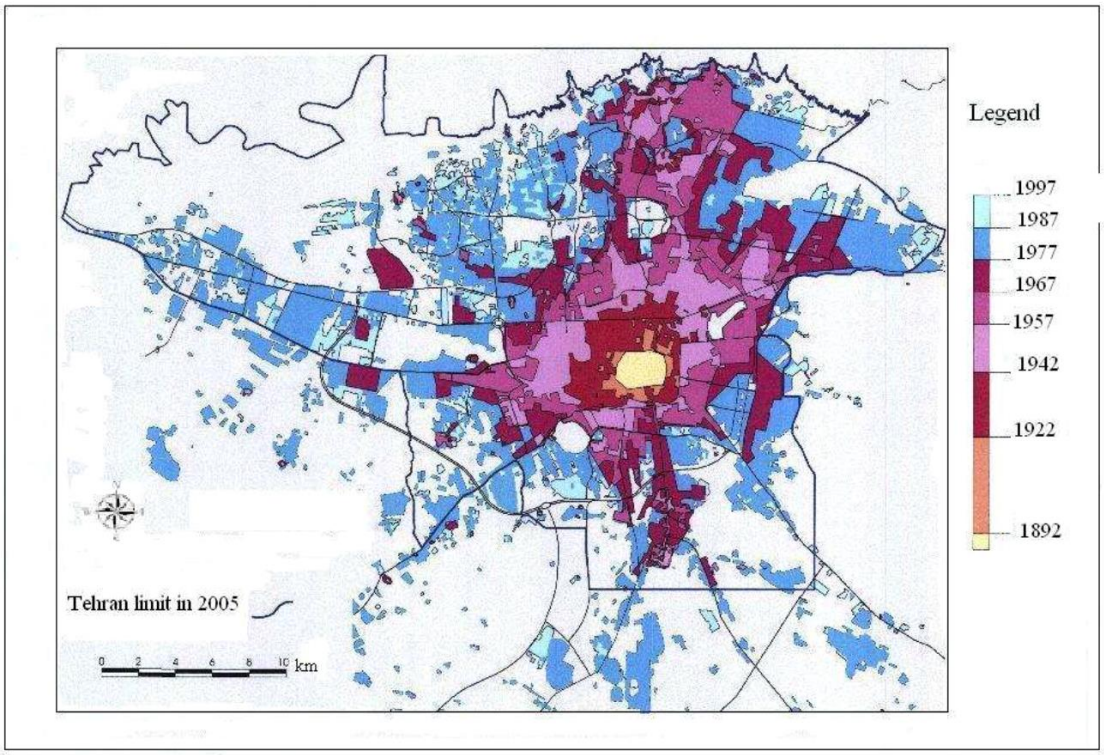
Table 3.1: Change of population, area, density and numbers of private cars in Tehran

Year	1921	1931	1941	1956	1966	1976	1986	1996	2000	2006
Population(million)	0.21	0.3	0.69	1.51	2.71	4.5	6.04	6.7	7.02	7.711
Area(hectare)	720	2420	4500	10000	19000	32000	62000	73950	78900	80000
Density(p/ha)	291.6	124	154	151	143	141	97.4	91	88.9	96.3
Private car(number for 1000 people)	-	-	-	5	25	31	61	74	83	90

Source: Roshan et al., 2010, p.45

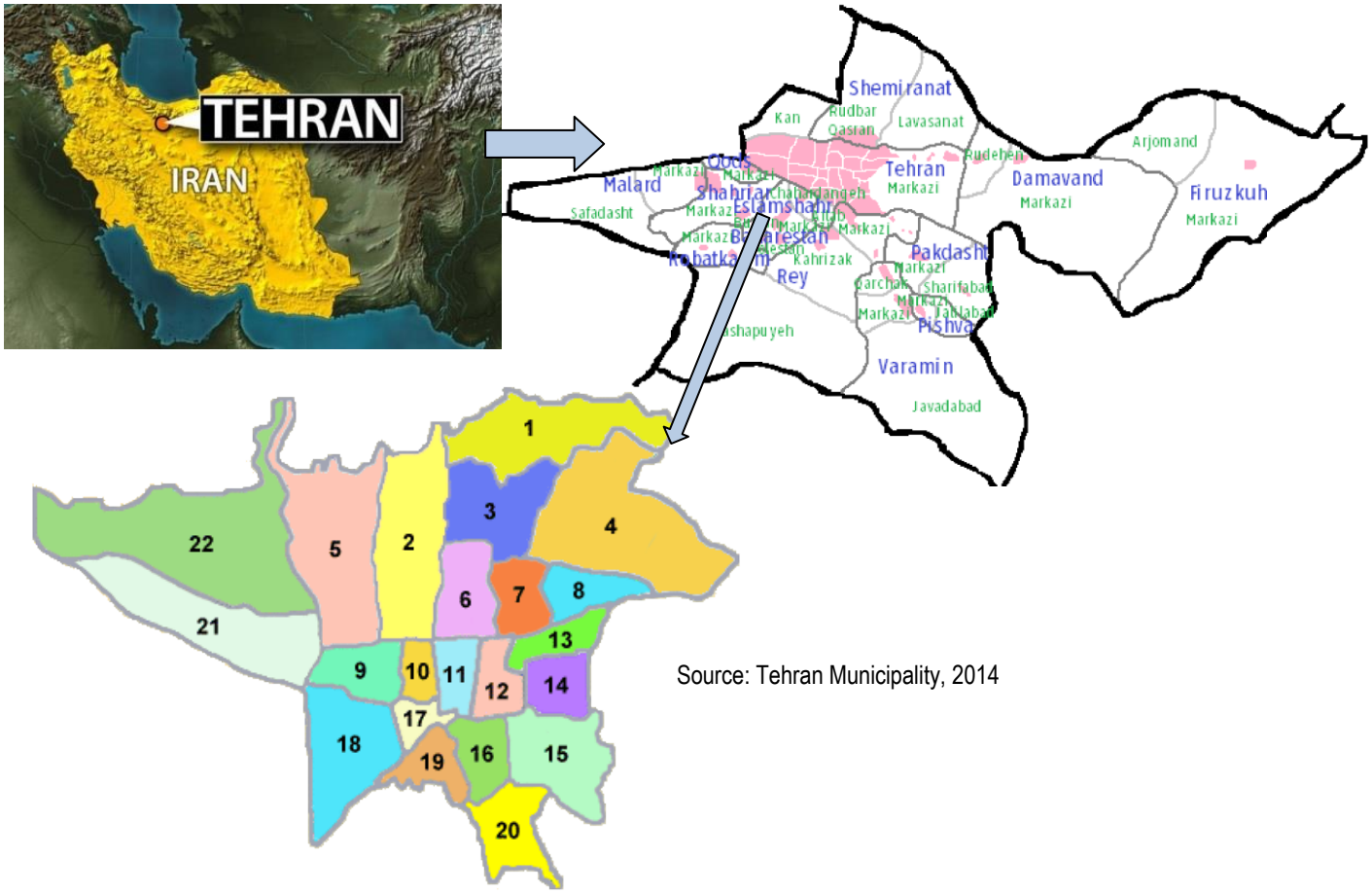
[1] The data in this chapter have been mainly selected from the official data of the Tehran Municipality Website.

Figure 3.2: The growth stages of Tehran



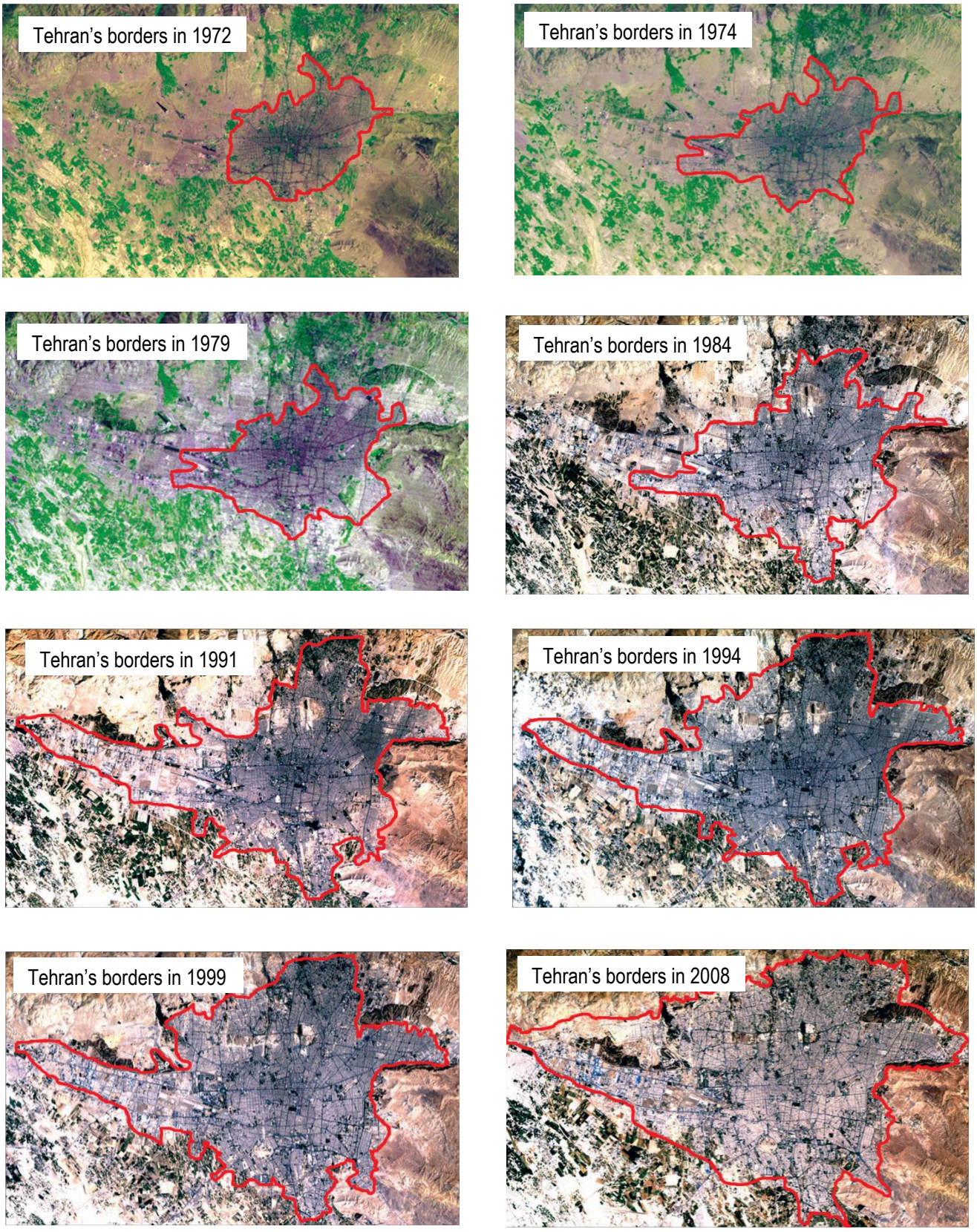
Source: Zanganeh Shahraki, 2007 quoted after Roshan et al., 2010, p.45

Figure 3.1: The location of Tehran in Iran, the city of Tehran in the Province of Tehran and the actual 22 regions of Tehran



Source: Tehran Municipality, 2014

Figure 3.3: Expansion of Tehran's borders, 1972 to 2008



Source: Tehran Municipality, 2014

3.2 Topography

Greater Tehran comprises a mountainous, a piedmont and a desert section (Figure 3.4). The mountainous section includes the heights over 1800 meters. From the south towards the north, the heights increase, so that the height difference between the highest point and the lowest in the province reaches 3000 meters. The height difference between 2 main squares in the north and south with 15 kilometers distance from each other is 200 meters. This difference in height results in a change of weather, better vegetation and beautiful countryside along the north. As we move from the south to the north, we observe many changes in the natural environmental conditions, property value, access to services and social conditions. In fact, the geographical slope corresponds to the social slope. In other words, the topography of the city is a reflection of its social-geographical topography.

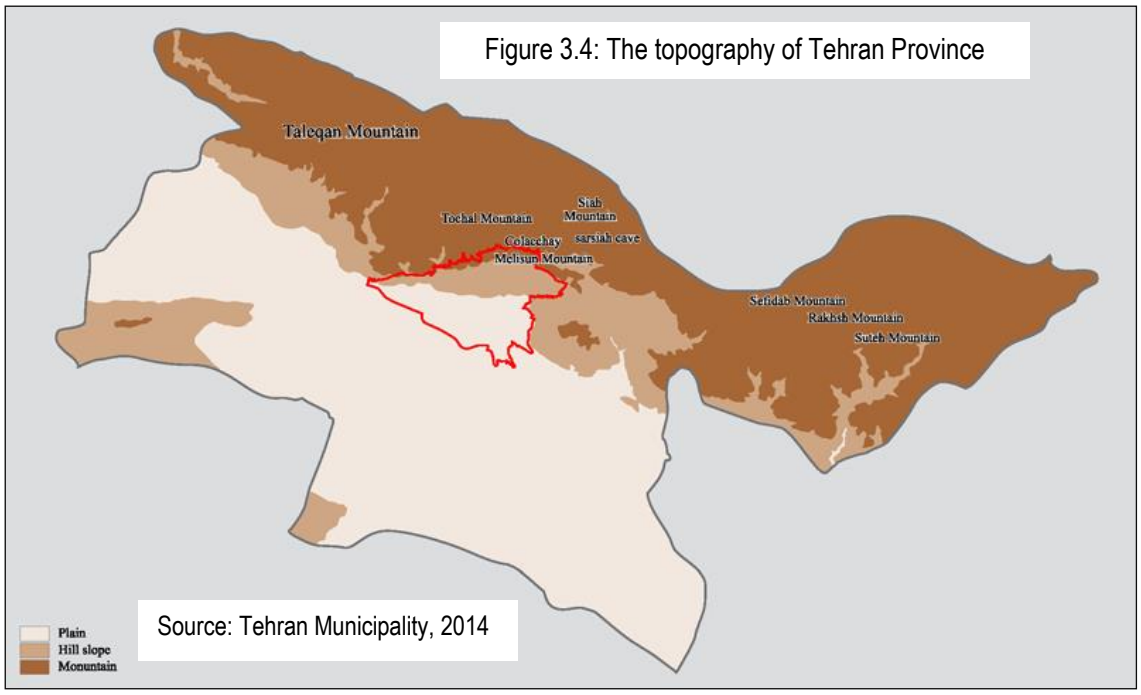


Figure 3.4: The topography of Tehran Province

3.3 The water resources of the province

The water resources can be divided into subsurface and surface waters. The subsurface water resources are being exploited by the use of wells, springs, and aqueducts. The Alborz heights in the north have provided appropriate grounds for precipitation and the forming of rich and ever-flowing rivers. There are many such rivers in the province that are used for industrial and agricultural purposes but five of them are the most important ones since they are wider and located in the city of Tehran shown and named in figure 3.5. Karaj River is one of the greatest rivers of the province, originating in the southern part of Alborz Mountain, 40 kilometers off the west of Tehran.

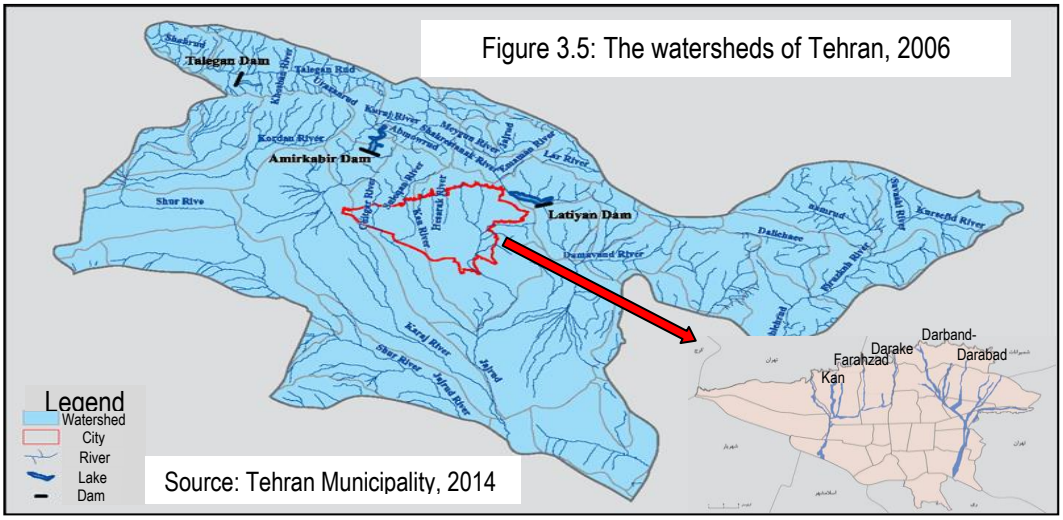


Figure 3.5: The watersheds of Tehran, 2006

3.4 Population and social characteristics

The various districts did not show the same population growth tendencies from 1976 to 2006. The central districts have widely lost their population while the urban districts have become more populated. This has resulted in a shift of population from the center to the suburbs, so much so that the population growth has been negative in districts 6, 13, 20 and 14 while district 4 has had the largest population and district 22 has experienced the greatest population growth. The districts in the outskirts experienced a population growth from 3% (1976) to 7% (1986), but from 1986 to 1996, however, they experienced a population decrease between 1% to 5%. This was due to the fast increase in land price in these districts after the revolution. In fact, the low value of land in the outskirts has been the main reason for people to rush into these districts. After the revolution, services were offered to the people living in these districts and accordingly the value of the properties raised, thus decreasing the striking differences between the value of land in the districts. In recent years the trend to restore old buildings has encouraged the people to stay in these districts and giving an end to the negative population growth.

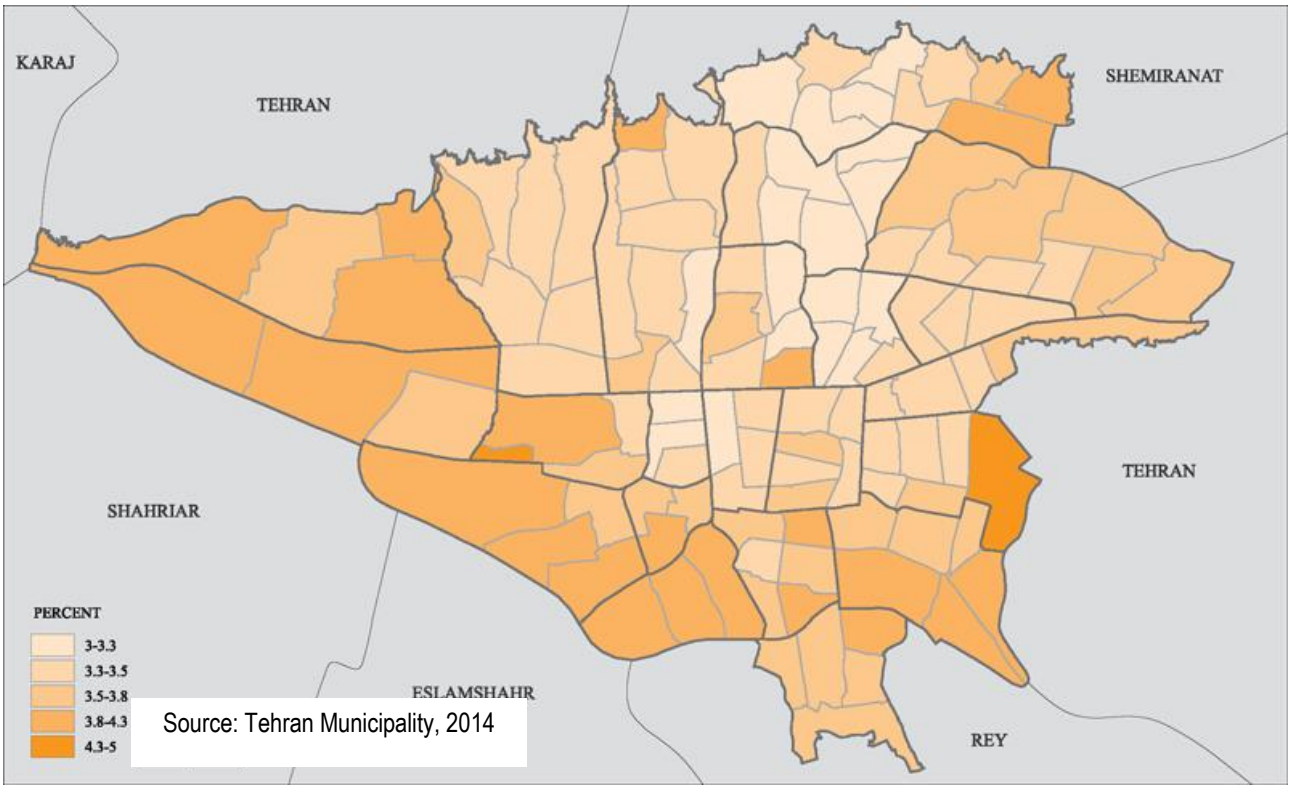
Table 3.2: Population of Tehran districts, 1976 to 2006

District	Population				Population Change (%)		
Distirict	1976	1986	1996	2006	1976-86	1986-96	1996-2006
1	182883	216467	249676	375881	2.8	1.4	4.1
2	220545	269482	458089	607003	3.3	5.3	2.8
3	222007	217084	237301	290272	-0.4	0.9	2.0
4	316904	479512	663166	810548	6.9	3.2	2.0
5	67199	243824	427995	675633	21.5	5.6	4.6
6	231683	258838	220231	236252	1.8	-1.6	0.7
7	327032	302217	300212	309938	-1.3	-0.1	0.3
8	365516	346474	336474	378544	-0.9	-0.3	1.2
9	200867	189805	173482	169988	-0.9	-0.9	-0.2
10	343551	311104	282308	315225	-1.7	-1.0	1.1
11	276712	247927	223965	274650	-1.8	-1.0	2.0
12	301701	230657	189625	246874	-4.5	-2.0	2.6
13	209600	245447	266700	245312	2.6	0.8	-0.8
14	398858	394111	450160	482682	-0.2	1.3	0.7
15	420561	622517	649370	641344	6.5	0.4	-0.1
16	347535	289474	303410	290348	-3.0	0.5	-0.4
17	353428	287367	264300	259857	-3.4	-0.8	-0.2
18	211606	296430	298600	316517	5.6	0.1	0.6
19	140354	216318	227389	245003	7.2	0.5	0.7
20	255653	356079	379750	323716	5.5	0.6	-1.6
21	–	188890	216970	154427	–	1.4	-3.4
22	31162	56020	67230	107130	9.8	1.8	4.7

Source: Tehran Municipality, 2014

Average size of households: The average number of household members in Tehran is 3.4 compared to 3.6 in Tehran province to national average of 4.3. The size increases as we move from the central and northern districts to the suburbs, because in the suburbs the fertility level is higher and the people living in these districts are mostly migrants characterized by a strong traditional culture; most of them have migrated with extended households. Districts with elderly population show the smallest household sizes due to a low fertility level. District 4 of region 9 has the greatest household size (5), followed by district 6 of region 14 (4.4) and district[1] 3 of region 9 (4.2). Districts 2 of region 7 and district 3 have the smallest household sizes (3).

Figure 3.6: The average size of households in Tehran regions in 2006



Population density**:** Another indicator of the cultural, economic and social identity is the population density. Based on the 2006 census, district 2 of region 10 with 434 persons per hectare and district 5 of region 15 with 402 persons per hectare exhibit the first and second highest population densities. Districts 1, 7 and 8 with an average population density of 350 people per hectare are among the high density areas. It is noteworthy that during 2006 the new areas of the city are still among those with the lowest population densities. Among these, district 3 of region 22 with 1.3 people per hectare has the lowest population density in the whole of Tehran. There are two main corridors of huge population densities. The first corridor starts from the southeast of the city towards central districts and is continued to the east side.

The second corridor with its north to west orientation is generally of lower density than the first corridor and shows a tendency towards the northern districts. The creation of such corridors can stem from selling building density and consequently more land speculation and construction, setting the policies in this field and economic status of families in different parts of the city. This part will be discussed thoroughly in next chapters.

[1]Tehran has 22 regions and each region has couple of districts but sometimes in the literature the term “district” is also used for the regions.

Figure 3.7: The population density in the regions of Tehran in 2006

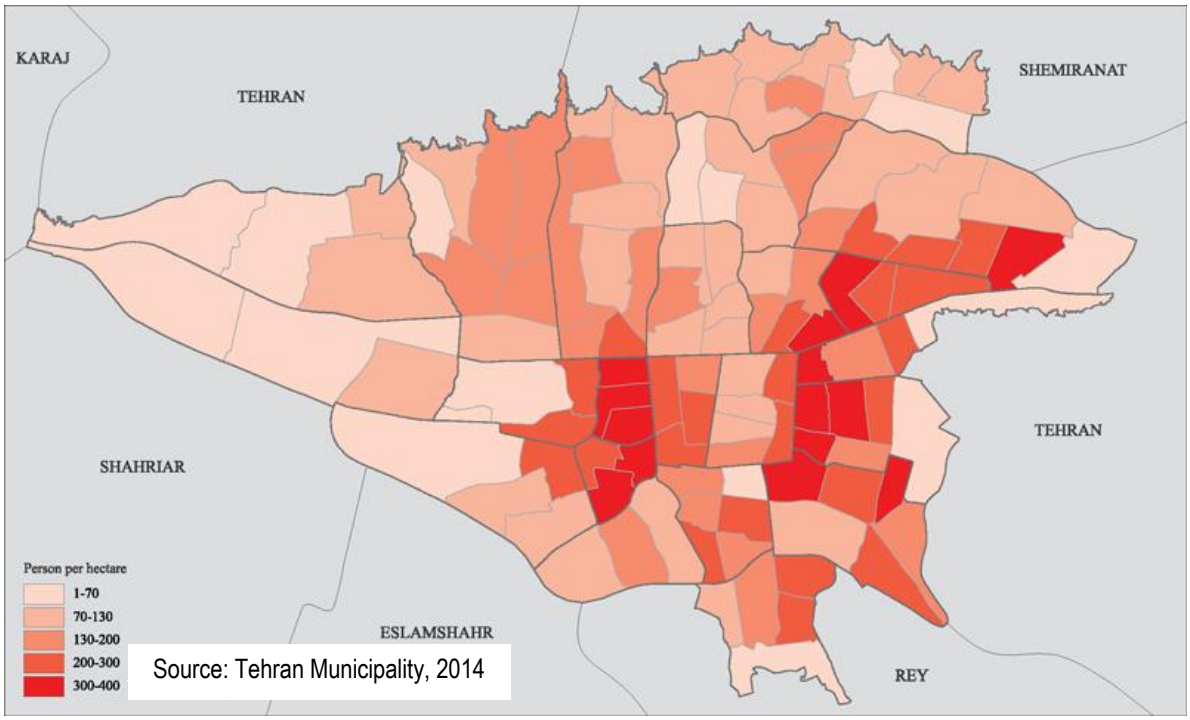
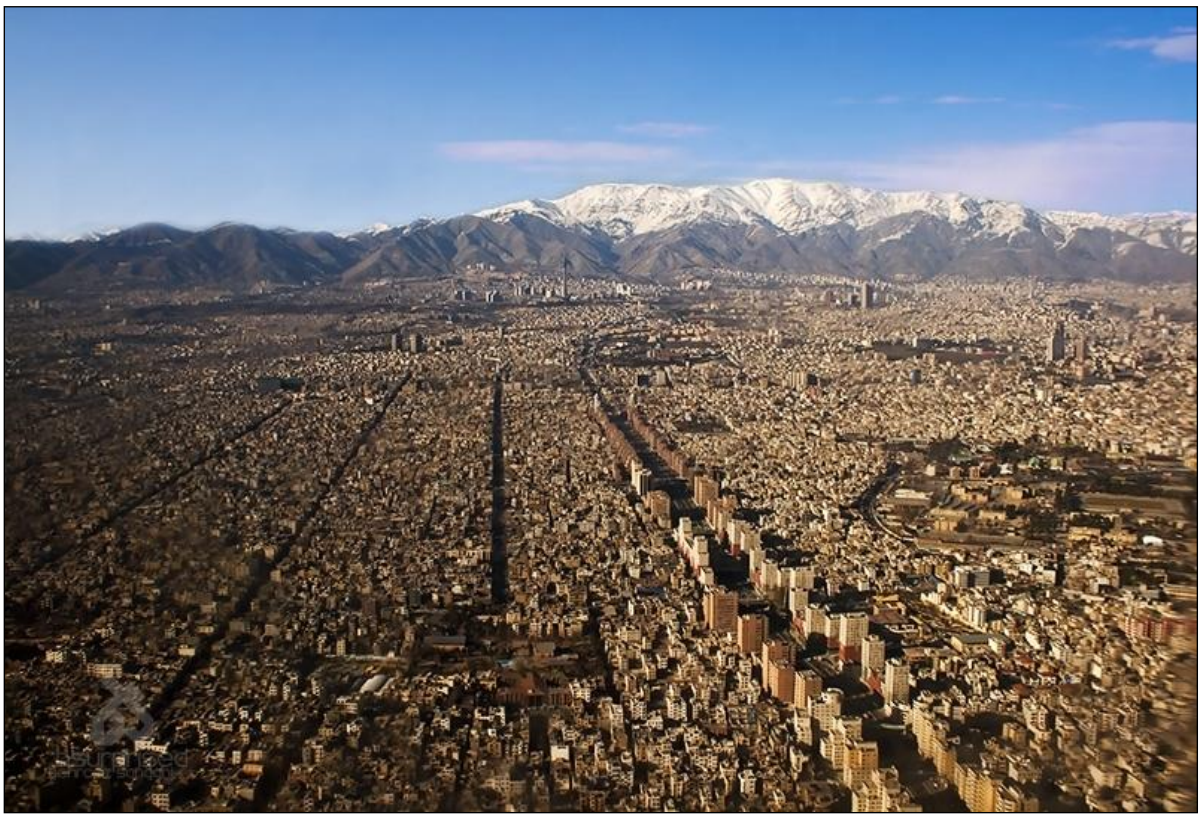


Figure 3.8: Aerial photo showing the city density from south to north in Tehran



Migration to Tehran: As a consequence of the economic breakdown of villages in the wake of Second World War, many villagers rushed to the cities, especially to Tehran, from 1939 to 1956 Tehran experienced a population boom. According to the 1966 census, more than 54% of the population (53% of the men and 56.5 of the women) were not born in Tehran. According to the 1976 census, about 55% of the population (53.3% of men and 57% of women) was not native to Tehran. In 1973, Greater Tehran was formed, which included the villages

surrounding the city of Tajrish. The new territory made better opportunities available for prospective migrants. According to the 1976 census, the population of this new territory was 4,530,223, only 2,495,052 of which were native to Tehran. From 1976 to 1986, some 496,000 people and, from 1986 to 1996, some 568,000 people migrated to Tehran, thus increasing the immigration population by 14% in comparison with the last decade. The people who migrated from 1986 to 1996 comprised 320000 men and 247000 women, with the sex ratio being 130. This ratio indicates that mostly male migrants came to Tehran to seek jobs or to continue their education. In 2006, Tehran province, with the migration balance of 617000, obtained the first rank among the provinces receiving immigrants. The most important reasons of immigrating to Tehran were to follow the head of the household (42%) and employment and education (9.9%). The people migrating to Tehran live in the villages of Tehran since the costs of living in Tehran are high. As a result, the rural areas of Tehran have increasingly become urbanized.

Figure 3.9: Migrants as percentage of the population in Tehran, 2006

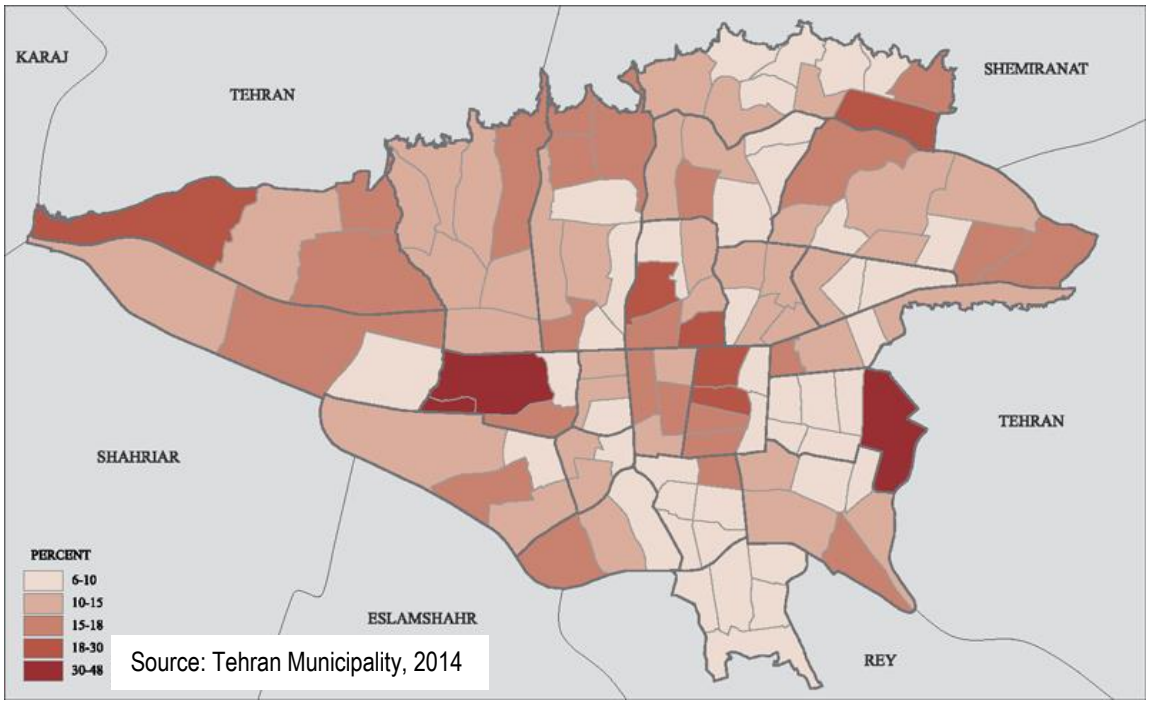


Figure 3.10: The Percentage of the people born in the regions of Tehran, 2006

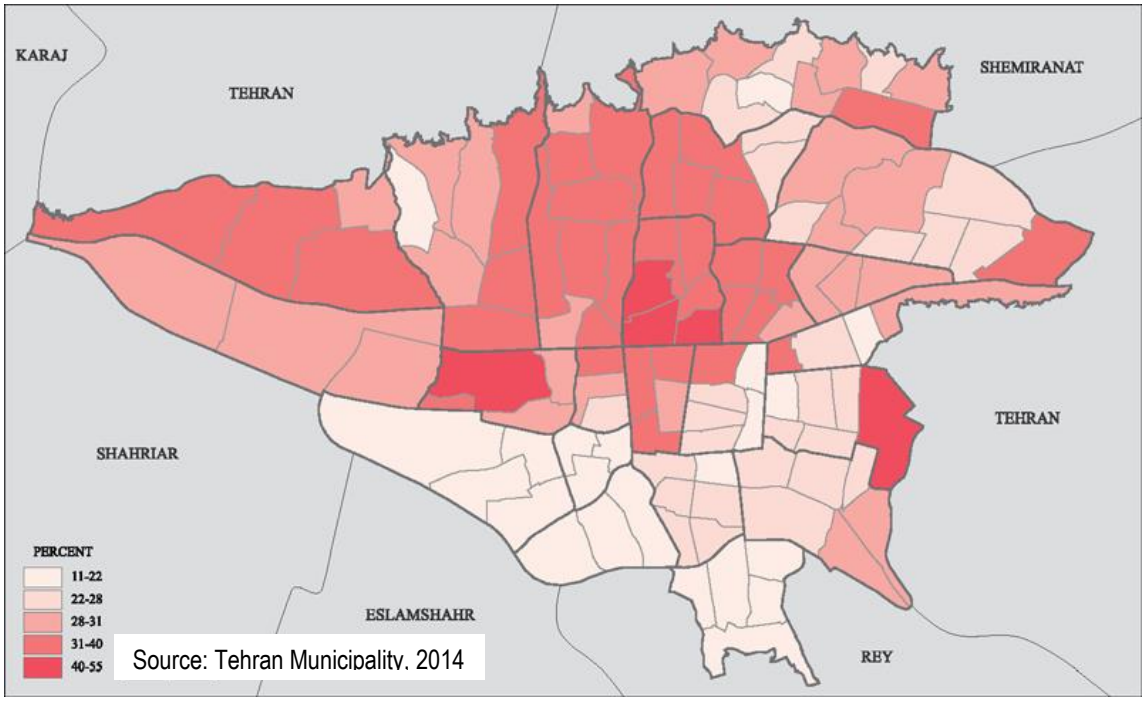
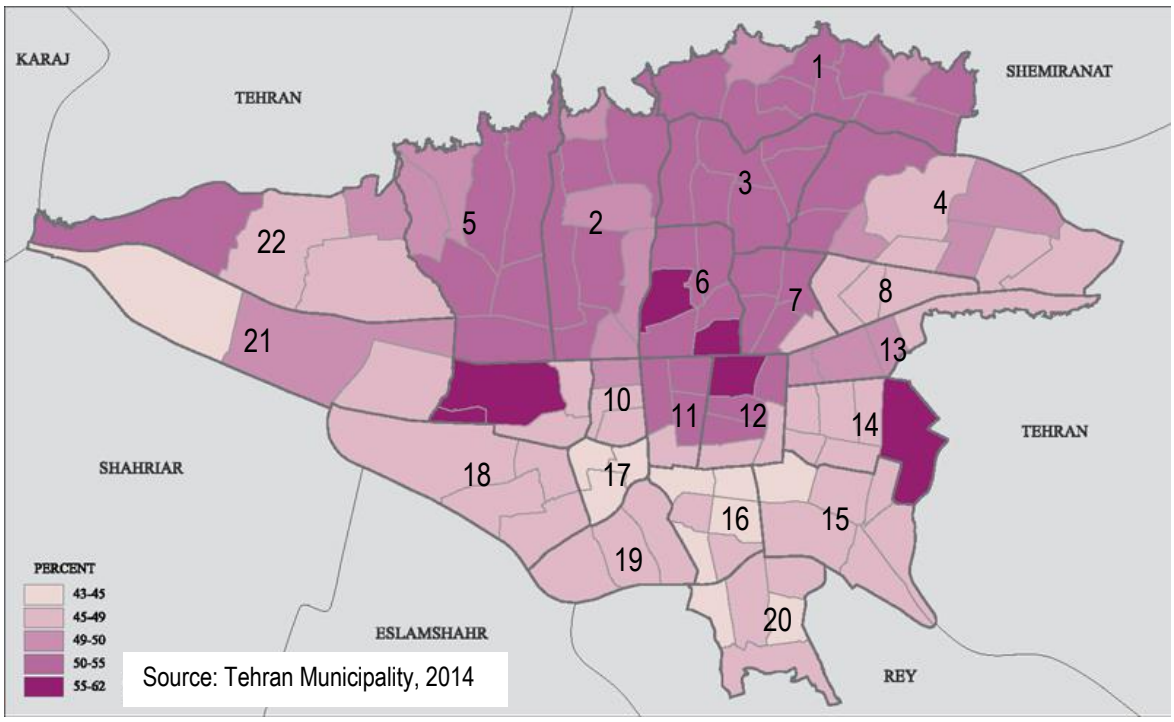


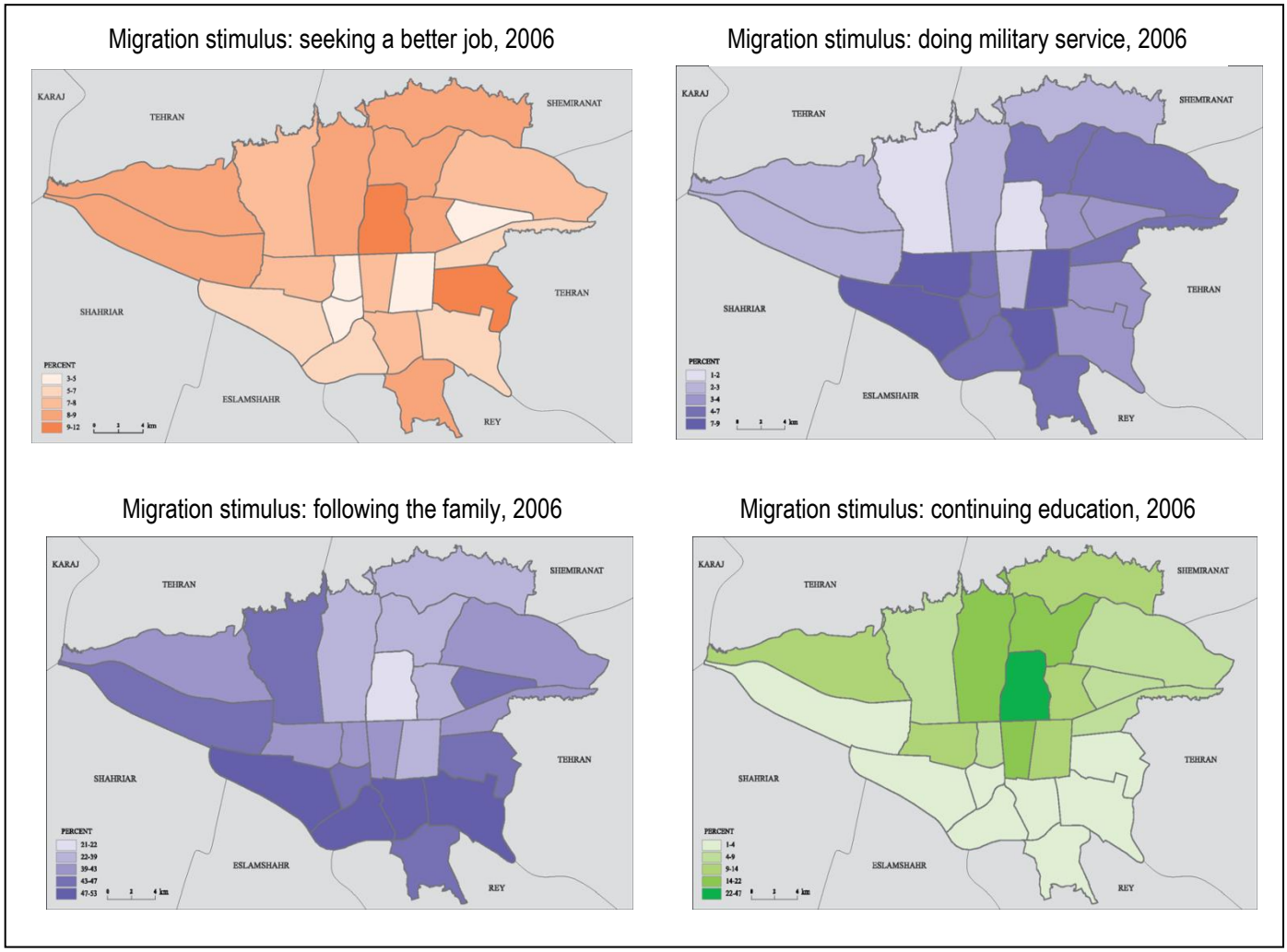
Figure 3.11: The Percentage of the people working or studying in Tehran



Causes of migration: An examination of the causes of migration can explain the function of each urban area or its characteristics. For example, in districts 1, 13, and 17 the residents are mainly governmental employees. District 6 is a university district, dominated by the people who have migrated to study in Tehran. Barracks are concentrated in districts 17, 21 and 22, so the people living in these districts are mainly army people. According to the Statistical Center of Iran, the main causes of migration during the years 1996-2006 are the following: family dependence (46%), employment (13.8%), military service (10.3%), studying (9.9%), and job transfer (5.1%). Figure 3.12 shows these reasons based on the regions.

Population distribution based on marital status: According to figures 3.13 and 3.14 which show the spatial distribution of married and divorced people in Tehran, divorced people showed the highest increase and reached to 7.9%. Various factors such as the existence of strong cultural tradition in suburban districts, pursuing higher education by high class individuals who postpone marriage, explain high marriage rate in the suburban districts and low marriage rate in high class districts. As far as the divorce ratio, the situation is quite the opposite. In the suburban districts, especially as we go toward Karaj, the rate of divorced people is the lowest, while in the central and northern districts, it is the highest. This is explained by the fact that the people living in the suburban districts have a more traditional culture. The amount of divorced women is much less in these districts in spite of the hard economic conditions. On the other hand, the people living in these districts are mainly young adult migrants

Figure 3.12: Reasons of migration to Tehran



Source: Tehran Municipality, 2014

Figure 3.13: Ratio of married people in the regions of Tehran, 2006

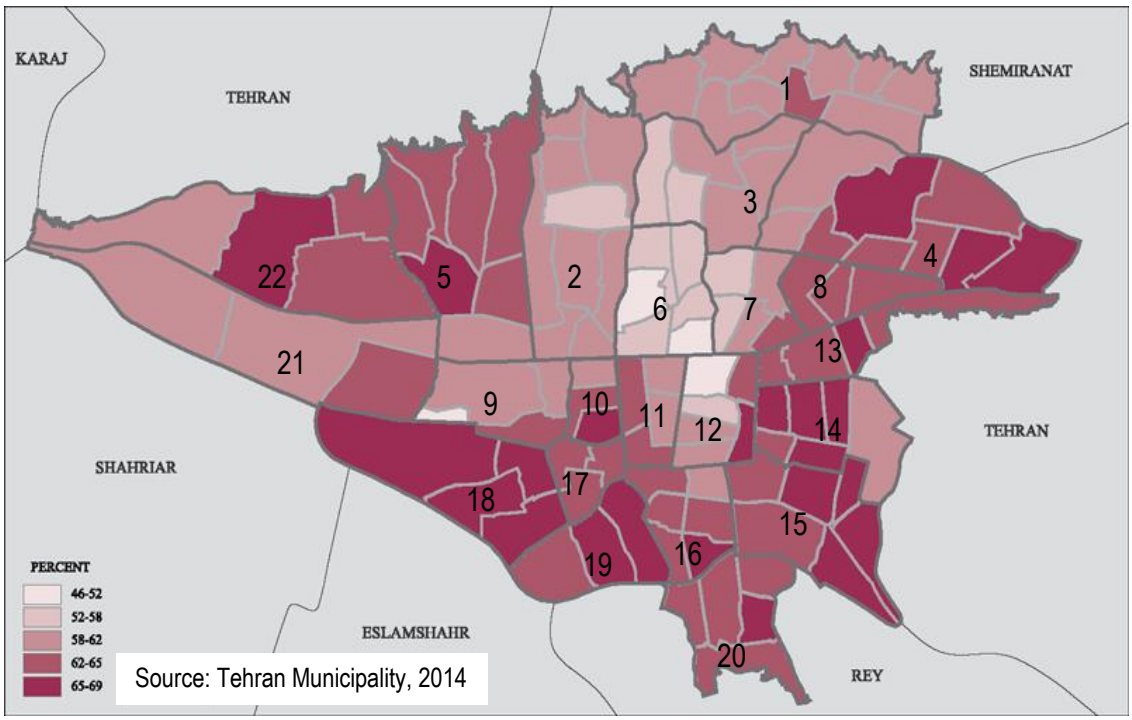
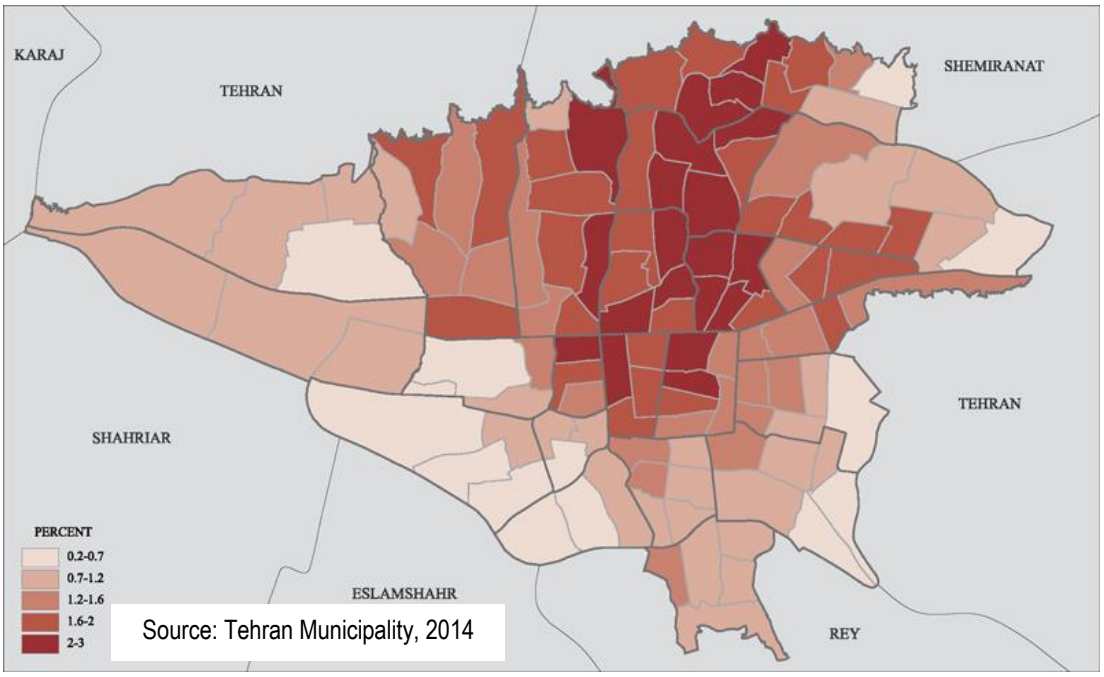


Figure 3.14: Rate of divorced single people in the regions of Tehran, 2006



3.5 Education status

To acquire knowledge has traditionally been considered a great cultural value by the Iranians. However, during the last 150 years, the change of the educational system from traditional to modern has not been smooth. Today the University of Tehran which has been established in 1934 has tens of thousands of graduates and is regarded as a symbol of higher education in Iran. At present, there are over 300 universities and higher education institutes in Tehran, turning the city into the greatest center of science and research. The ratio of literacy, an indicator of development, is obtained by dividing the number of literate people of a society by the above 6 years old population. According to the 2006 census, the Tehran ratio is 90% on average, varying between 80 to 99% in various districts. Even though the difference is not very distinct, its spatial distribution clearly shows the difference between the northern and southern parts of the city. The number of literate persons in a household as a quality index of population both indicates the literacy level of the household and the eagerness of the household to acquire of literacy. According to figure 3.15 the northern regions have more literate members in the household. This shows the high socio-cultural status of these regions.

Figure 3.15: Literacy Ratio in Tehran-2006

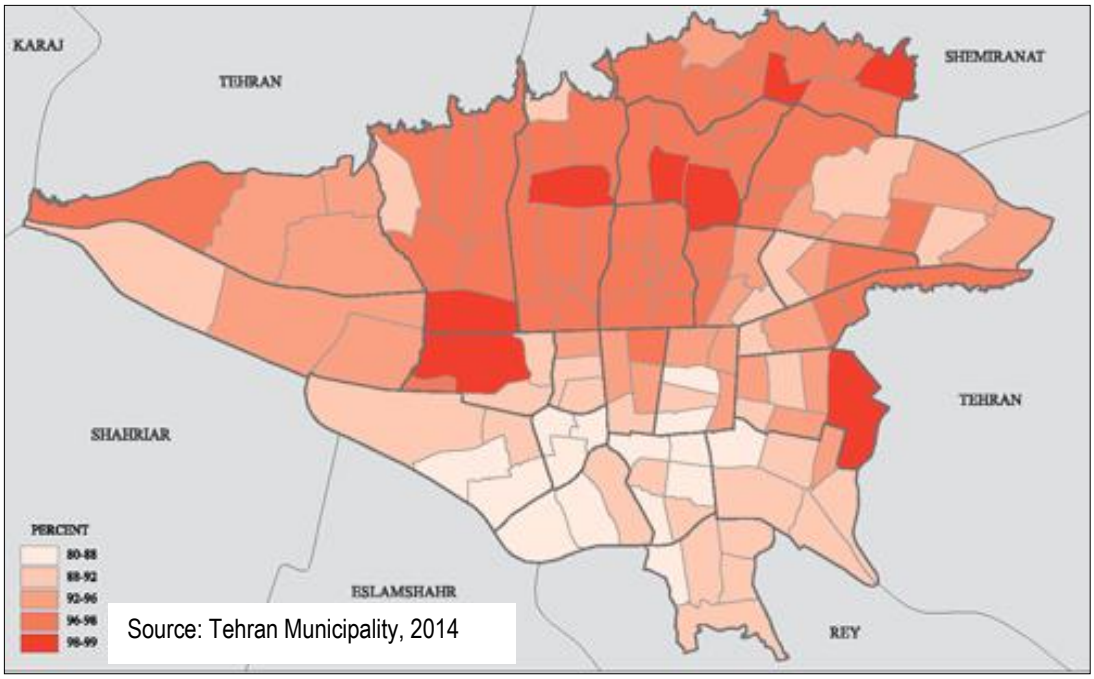
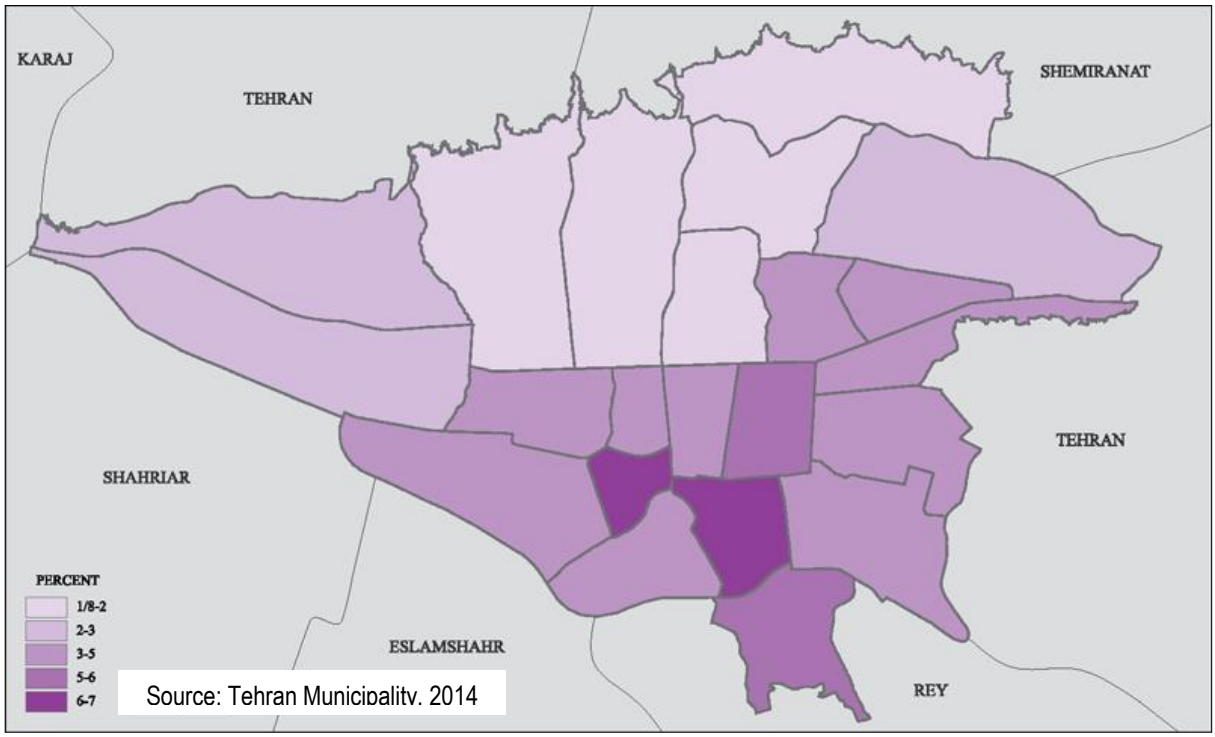


Figure 3.16: Household without a literate member



Consequently, as far as the spatial distribution of the people with a university degree concerned, the regions 1, 2, 3 and 6 have the highest ratio, while certain areas in the south have the lowest.

Figure 3.17: Population with higher education in the regions of Tehran

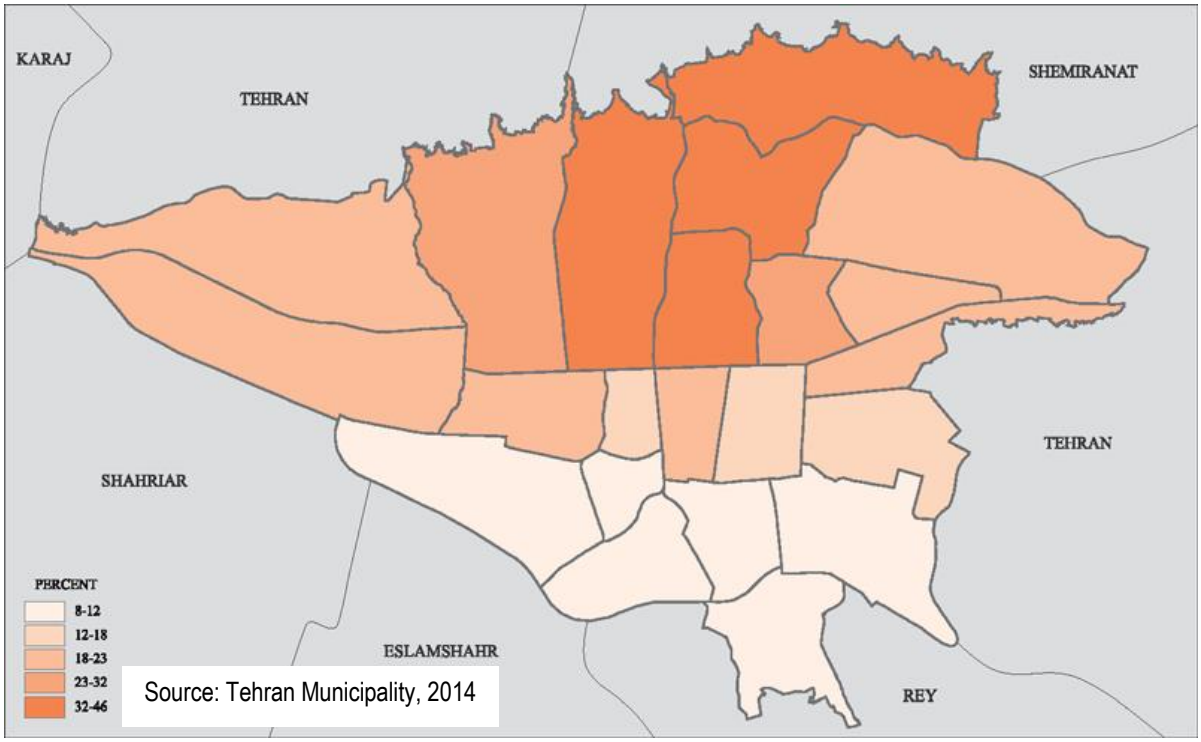


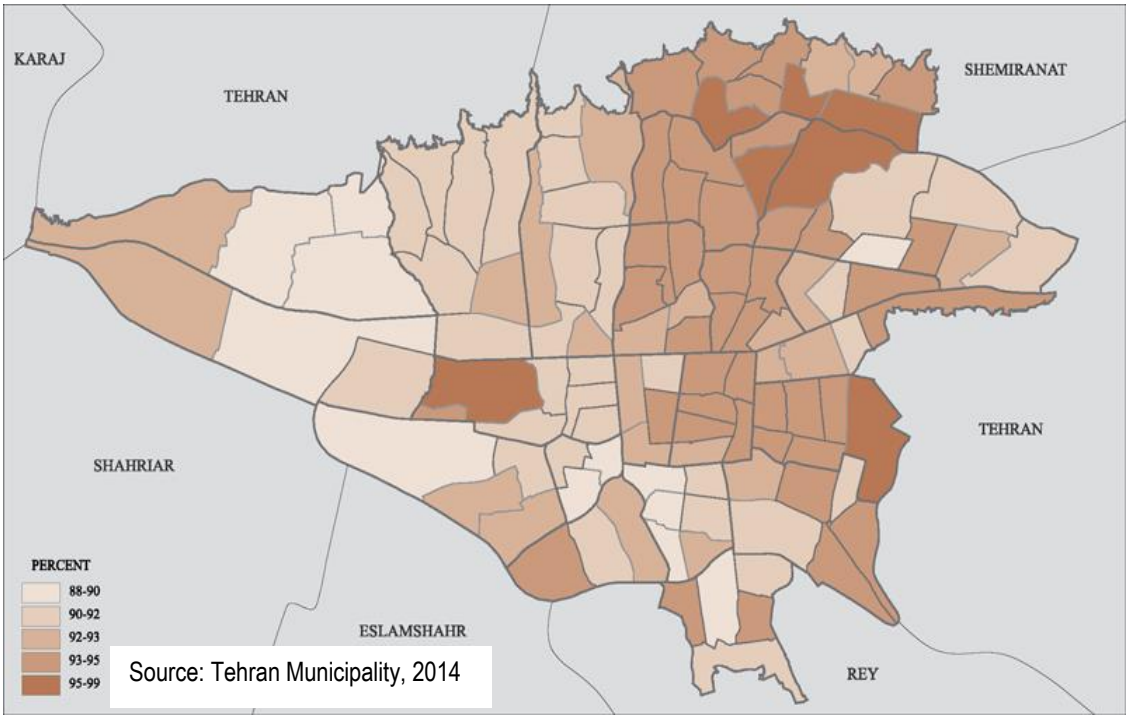
Figure 3.18: University of Tehran

Source: University of Tehran, International Campus of Kish website, 2014

3.6 Employment and job

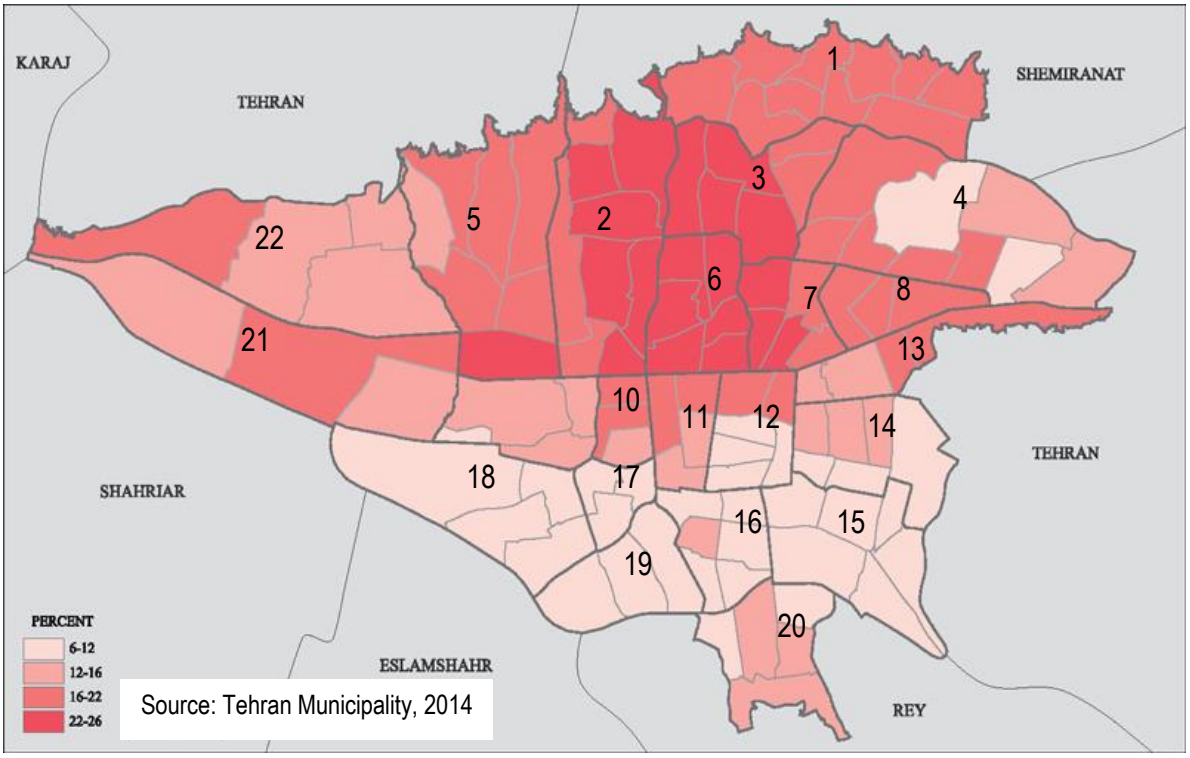
The employment rate is defined as the ratio of the employed population to the total economically active population. It indicates the power of the society in using its material and spiritual assets. As shown in figure 3.19, this rate increases from center to north and north- east of Tehran. The spatial distribution pattern of employed women in various districts of Tehran shows that in 2006 and earlier, the greatest number of employed women lived in the northern half of the city and that the difference between the south and the north was quite palpable (Figure 3.20).

Figure 3.19: The employment rates in the regions of Tehran, 2006



Source: Tehran Municipality, 2014

Figure 3.20: Employed women in the regions of Tehran, 2006



In 2006, the spatial pattern of the unemployment rates shows high values in most districts in the south and the west, whereas the districts in the eastern half, the corridor from the center to the north shows a low unemployment rate. This can partly be explained by the fact that the inactive population seeking jobs mostly live in the center and northern parts of the city.

Figure 3.21: Unemployed rate in the regions of Tehran in 2006

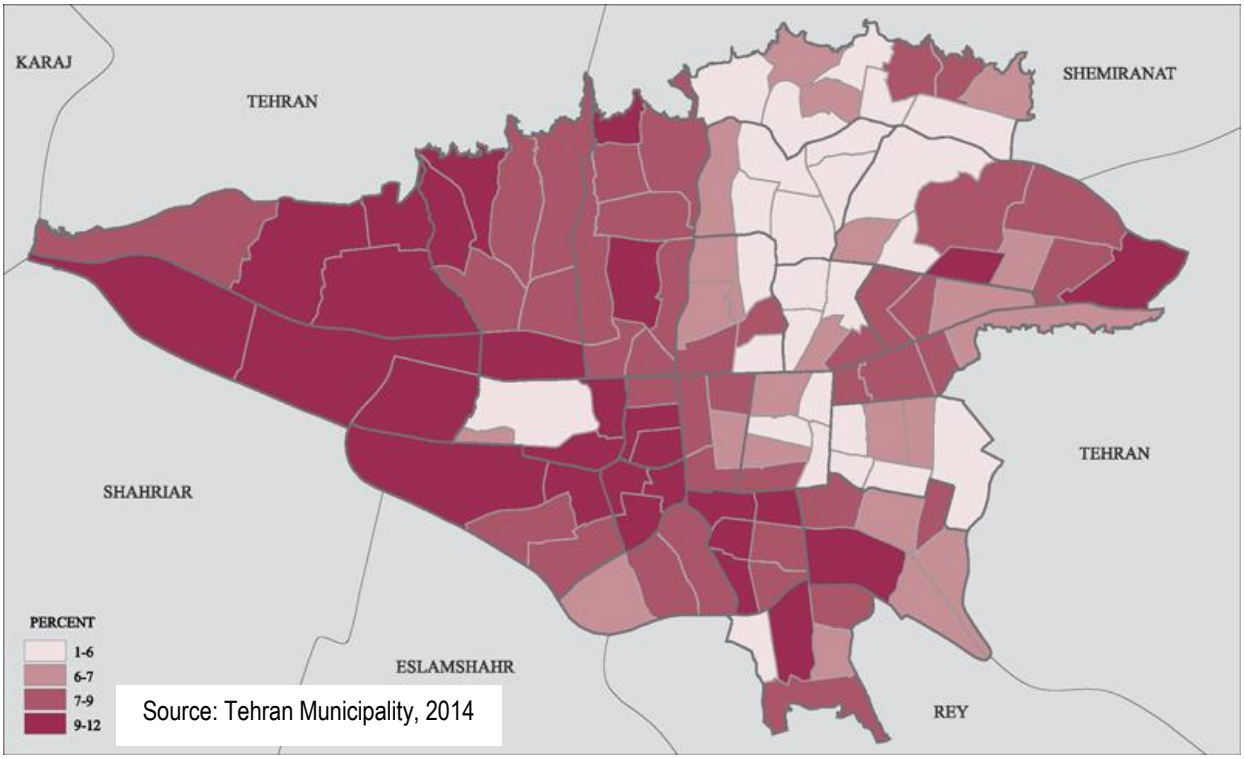
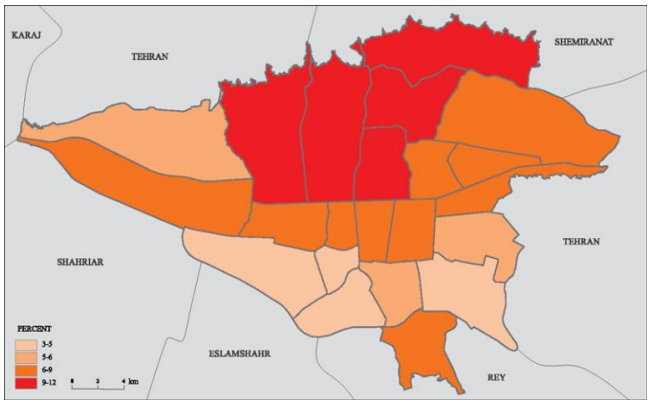


Figure 3.22 shows the different job groups which are to indicate for social status as well as the level of education. In terms of economic distribution, Tehran has a unique status. In the south of the city, there is a concentration of transportation, industry and assembly jobs. Health and social work-related jobs are also concentrated in the south.

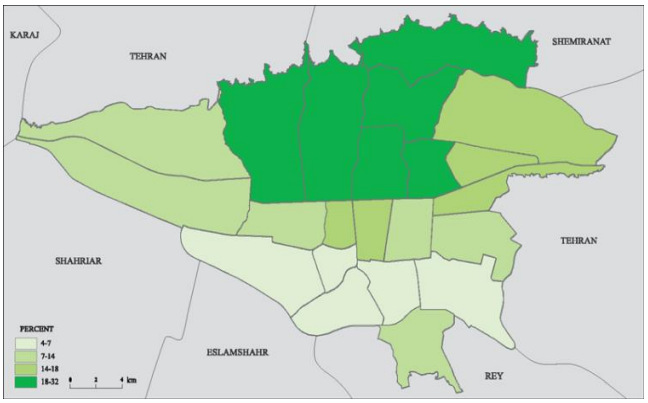
The government-related jobs, technicians, assistants, specialists, law-makers, managers and other government employees are concentrated in the northern parts of Tehran.

Figure 3.22: Different job groups in the regions of Tehran

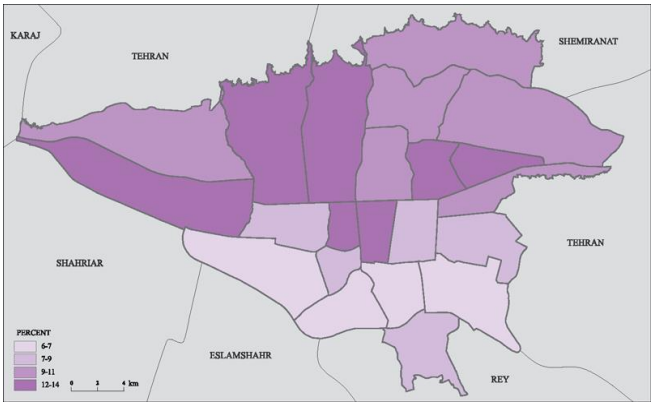
Occupational Affairs



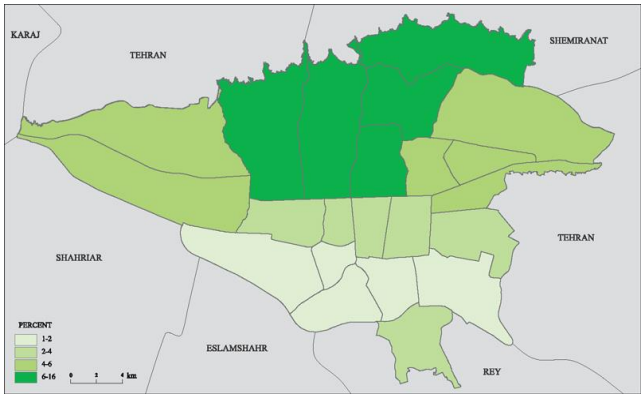
Highly qualified academics



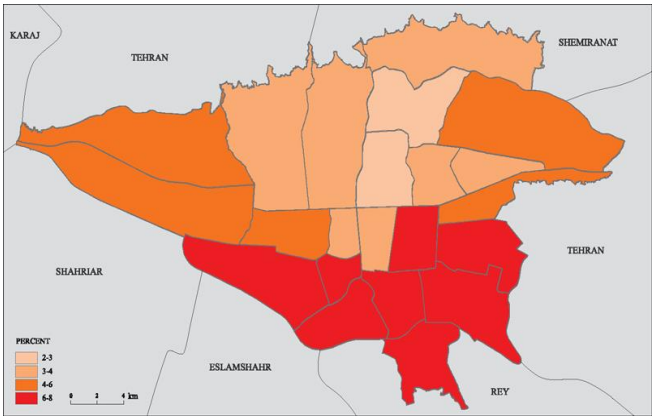
Technicians and assistants



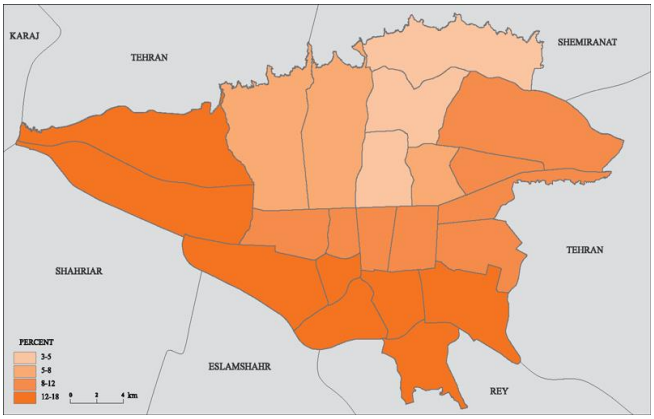
Legislators and administrators



Health and social work



Assemblers, operators and vehicle drivers



Source: Tehran Municipality, 2014

Figure 3.23: Concentration of vehicle drivers in Region 18 in the south of Tehran

Source: Author

As a population quality indicator, dependency indicator shows in numbers the ratio of employed to unemployed people. A low ratio indicates the desired welfare and saving power whereas a high ratio shows a low welfare status in a society.

Figure 3.24: Welfare in northern regions of Tehran

www.namnak.com quoted after http://www.hammihan.com

Figure 3.25: Dependency Ratio in Tehran, 2006

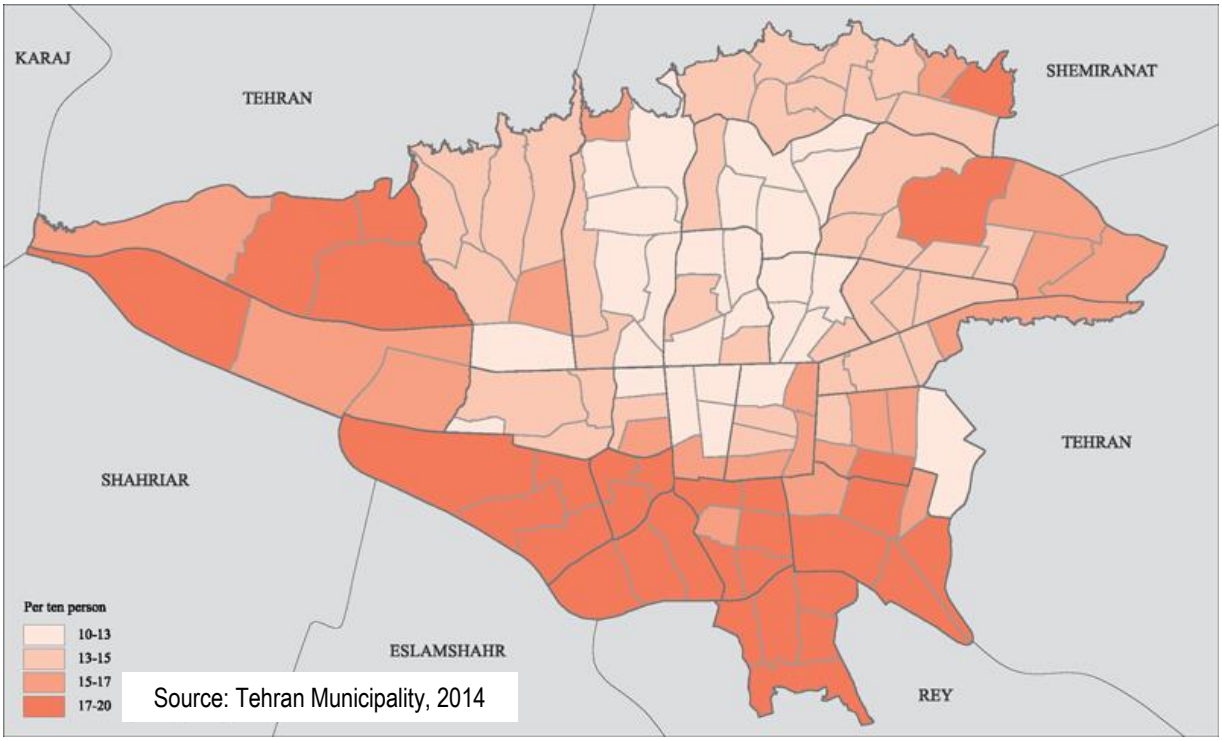


Figure 3.26: Poverty in the southern regions of Tehran

Source: http://anthropology.ir

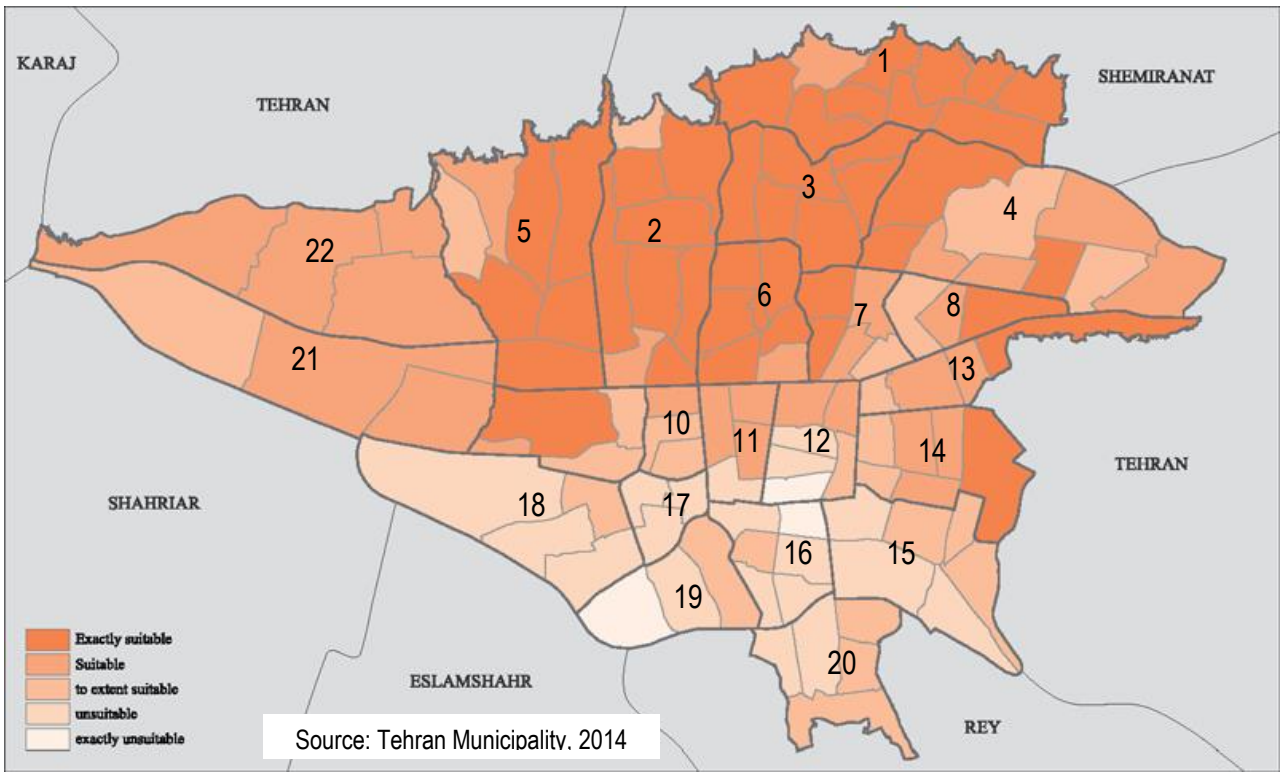
Figure 3.27: Poverty versus wealth in south and north of Tehran

Sources: the left photo: http://sasanvelenjak.ir and the right photo: www.Peyvand.com

3.7 Overlaying the socio-economic maps: social capital quality in Tehran

A multidimensional study requires combining different layers and maps to create a certain map comprising all the social, economic and cultural aspects. The social capital quality which shows this combination consists of indicators such as the rate of education, the rate of education of men and women over 6, the number of family members, the rate of employment, the number of unskilled workers employed as well as the residences with three or more bedrooms and floor spaces of over 101 to 200 square meters. As shown in figure 3.28, the northern and central north districts rate best. Also the western and eastern districts have a good social capital where the southern, southwestern and central south districts have the poorest. Tehran can be divided into a northern and a southern part. All the detailed maps of this chapter are to approve the structures exhibited in this comprehensive map.

Figure 3.28: The quality of social domain (social capital quality) of the regions of Tehran, 2006



3.8 Housing

Housing is one of the most serious problems in Tehran. The quality and quantity of housing has been a major issue for many decades, especially since the rapid urban growth in the 1970s. From 1996 to 2006, more than one million, that is, 607,000 families were added to the population of Tehran. The greatest number of houses has been built in 2001, when about 168,000 construction licenses have been issued, whereas in 2005 the number of licenses issued had been as low as 64000.

Average floor space of residential units: The main difference between the indicators of housing in Iran and those of other countries is that these indicators are relatively high in Iran, even if compared with those of developed countries. For example, in the 1980s, the average floor space per residential unit in Iran was more than 140 sq m., whereas in Japan and in the all European countries it was less than 100 sq m. The reason should be sought in the cultural and social conditions and the needs of the Iranian families, and not necessarily in their financial conditions. In Tehran, this indicator has two major characteristics. First, the average floor area of residential units in Tehran is more than 100 sq m., which is much higher than in other countries. Second, there is a considerable difference between the average floor areas in various parts of the city. Floor area per capita in Iran is 20.8 sq m whereas according to WDI, 2003 this ratio is 14.97 in the developing countries. (Table 3.3) In Tehran, the average floor space in various parts of the city follows the same pattern as the average number of people residing in a residential unit. In the south, residential units have the smallest floor space (between 50 and 70 sq m) whereas in the north, (especially in regions 1 and 3), floor spaces vary in size between 130 and 175 sq m. The units situated in southern and western regions have recently been built and show an average space of 100 sq m. This difference is mainly due to the difference in the financial status of the families which increase from the south to the north. In addition to the economic factor, there is an environmental factor in the northern regions as their residential units are mainly houses that require greater floor spaces and a greater number of people.

Figure 3.29: Residential units with 75- 85m^2, 2006

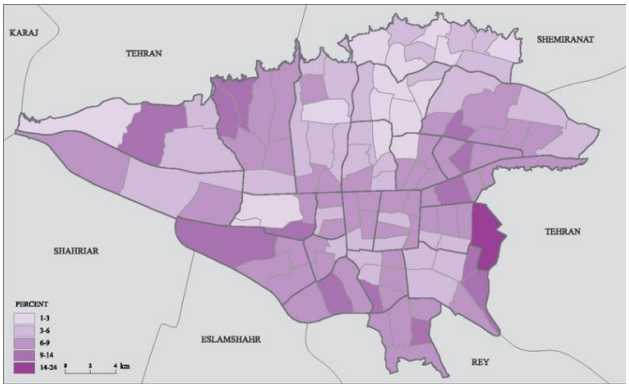
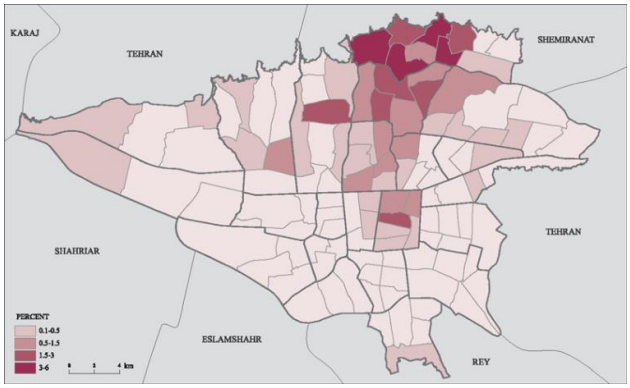


Figure 3.30: Residential units with 300- 500m^2, 2006



Source: Tehran Municipality, 2014

Table 3.3: Residential floor area per capita in different countries compared to Iran

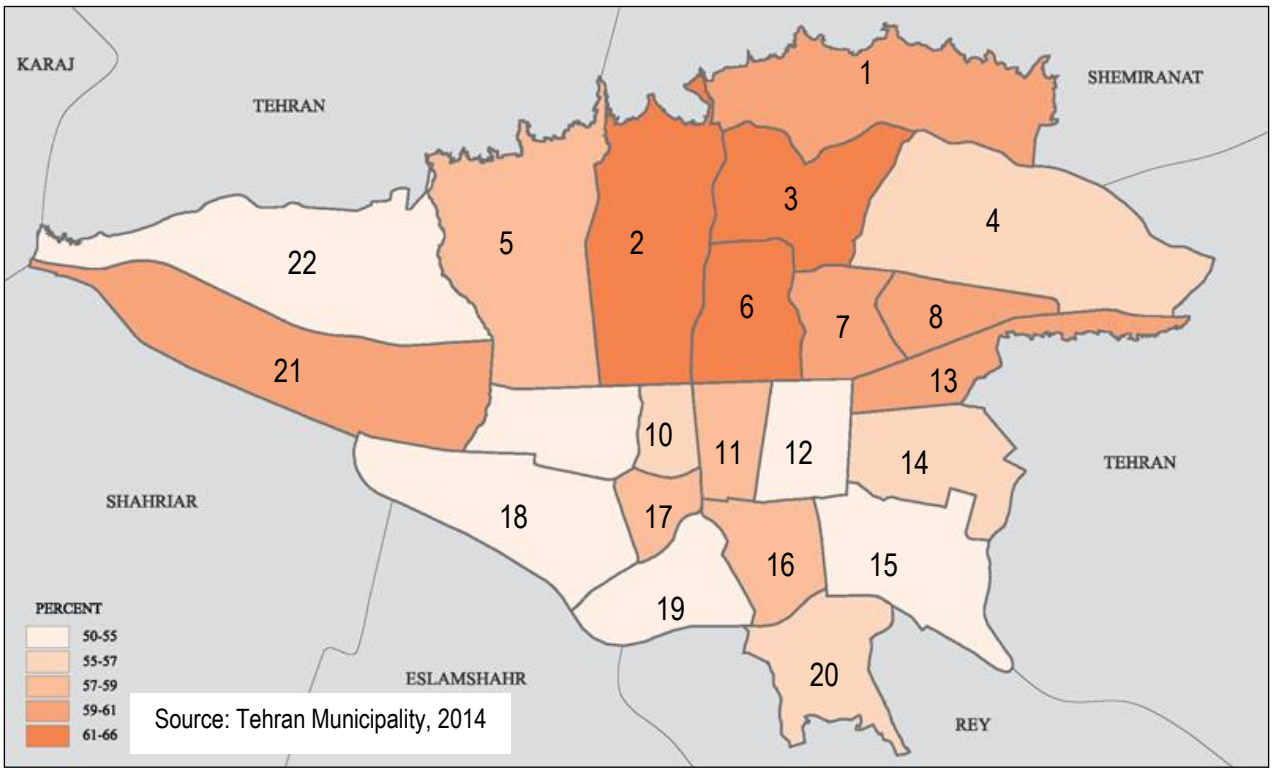
Country	Residential floor area per capita	Country	Residential floor area per capita	Country	Residential floor area per capita	Country	Residential floor area per capita
Tunisia	6.5 m^2	Jordan	10 m^2	Thailand	16.48 m^2	Brazil	19.3 m^2
Algeria	8.5 m^2	Egypt	12 m^2	Poland	17.4m^2	Iran	20.8 m^2
Nigeria	9 m^2	Venezuela	16 m^2	Malaysia	18.58m^2	Palestine	24.8 m^2
China	9.34 m^2	Turkey	17 m^2	South Korea	18.8m^2	Developed Countries	44.5 m^2

Source: WDI, 2003 quoted after the Housing Section of Ministry of Roads and Urban Development, Tehran, 2014

3.9 Property ownership

The property ownership indicator explains if a property is owned by a private person, if it is rented, if it is free of charge or if it is a governmental property. About 57% of households in Tehran own the housing units in which they live. In more affluent areas, such as regions 5, 9, 10, 11 and 12, the ownership rate varies between 51% and 55%. But 31% of the households live in rented and flat units and 2.7% live in free properties (Figure 3.31).

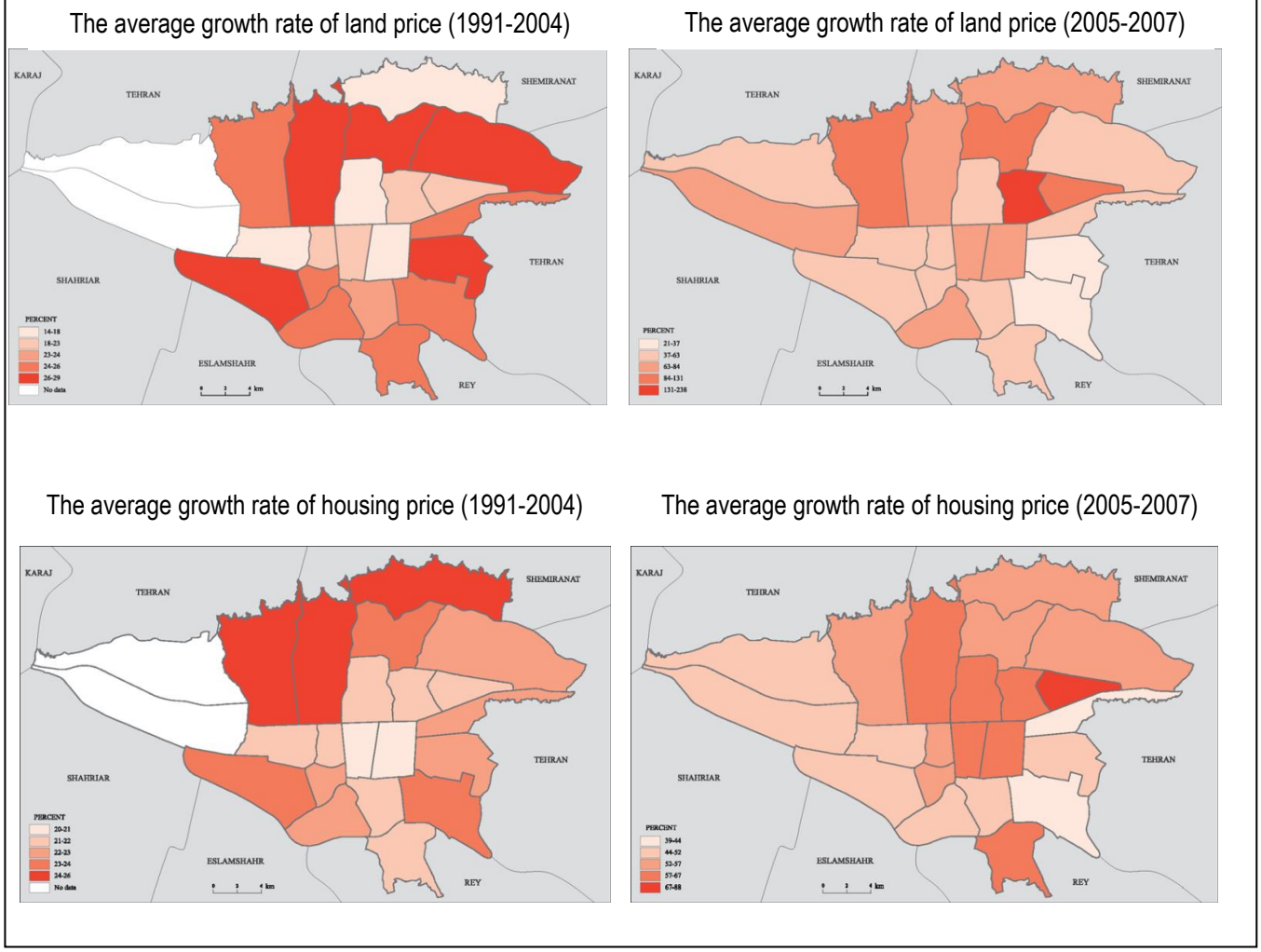
Figure 3.31: Households owning units, 2006



3.10 Property value

The recent decade has been happened to see fluctuations in construction costs, property values, property transactions booming and recession periods. Changes in the value of properties have been dramatic. In 1996 and 2007, the increase of the value of one square meter of residential unit reached its peaks: that is, 67.3% and 81.6% respectively. In 1997, 1998 and 2004, the growth rate of one square meter of residential unit has been negative: that is, -2.7%, -0.1 and -2.6 respectively. The other characteristic of the housing market in Tehran is the changes in the spatial distribution of production and value of properties in various districts. From 1996 to 2006, buildings have mainly been constructed in marginal areas inside the city. Based on the available information, the construction licenses issued for residential units were the highest in regions 5, 2, 4, 1, 7 and 15. From 1991 to 2004, Tehran had the highest increase in property values in regions 5, 2, 1, 3, 15, and 18 and from 2005 to 2007, regions 2, 6, 7, 8, 12, 11, and 20. Even though the Tehran property market affects the property market throughout the country, it is affected by macro economy changes, especially the growth of liquidity and the interest rate from other forms of investment in the country. Economic sanctions imposed from the west on Iran could also be mentioned as one of the reasons why more money has been invested in land and national properties after all the doors of the country had been closed to the outside. In a weak economy like this, property was represented as a force investment. As a result in this economic system land speculation has become a job which made many Tehran residents rich in a short time. As very common in developing countries, all these activities were more and less focused on the capital city and many immigrants moved from other cities to Tehran in order to find a job and consequently a place to live. Therefore all the new constructions were not unoccupied (Figure 3.31). But the recent reports show that, at the moment, 500,000 residential units are unoccupied.

Figure 3.32: Housing price and Land price in regions of Tehran



Source: Tehran Municipality, 2014

Since December 2008, all property transactions in Tehran are obliged by law to be registered in a central database system called "Iranian Property & Tenement Data Management System". The main purpose of establishing such database was to clarify the transactions in detail. Figures 3.33-3.35 try to compare the housing/real estate market of Tehran[1] in summer 2011 and winter 2010. Regions 1, 2 and 3 have relatively higher price of building plot due to their good location and the high social level of the residents living in them. Region 6 can compete with the first regions in this field because of its centrality. This region is in the city center and therefore most of the parcels have the commercial land uses and high prices of land. Relating residential properties, region 1 has the highest prices both in rental and purchasing. Once again region 6 has higher prices in comparison to other regions and this stems from the accessibility to work, Bazaar, university and the city center. In general, there is a significant increase in all regions in all different fields in summer 2011 in comparison to winter 2010.

[1] According to Iranian Central Bank the official exchange rate for Euro to Iranian Currency in 12 May 2012 was 1583 Tomans to a Euro. In open market this rises to 2100 Tomans for a Euro. However, by the end of 2012 Rial/toman value dropped dramaticaly and in the beginning o f 2015, 1 Euro equals 4300 Toman.

Figure 3.33: Mean square meter price of building plot in different regions of Tehran during winter 2010 and summer 2011 (per Tomans)

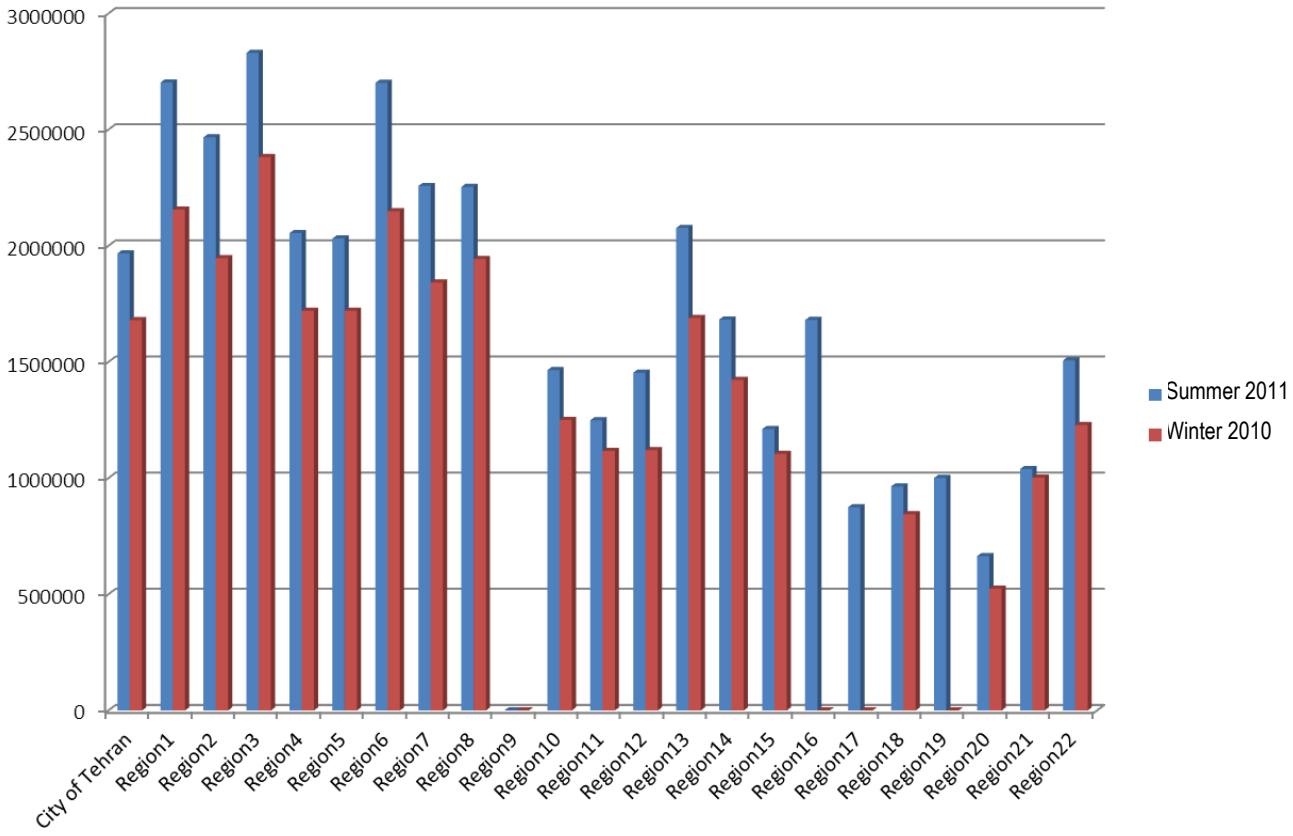


Figure 3.34: Mean square meter price of purchased residential property in different regions in Tehran during winter 2010 and summer 2011 (per Tomans)

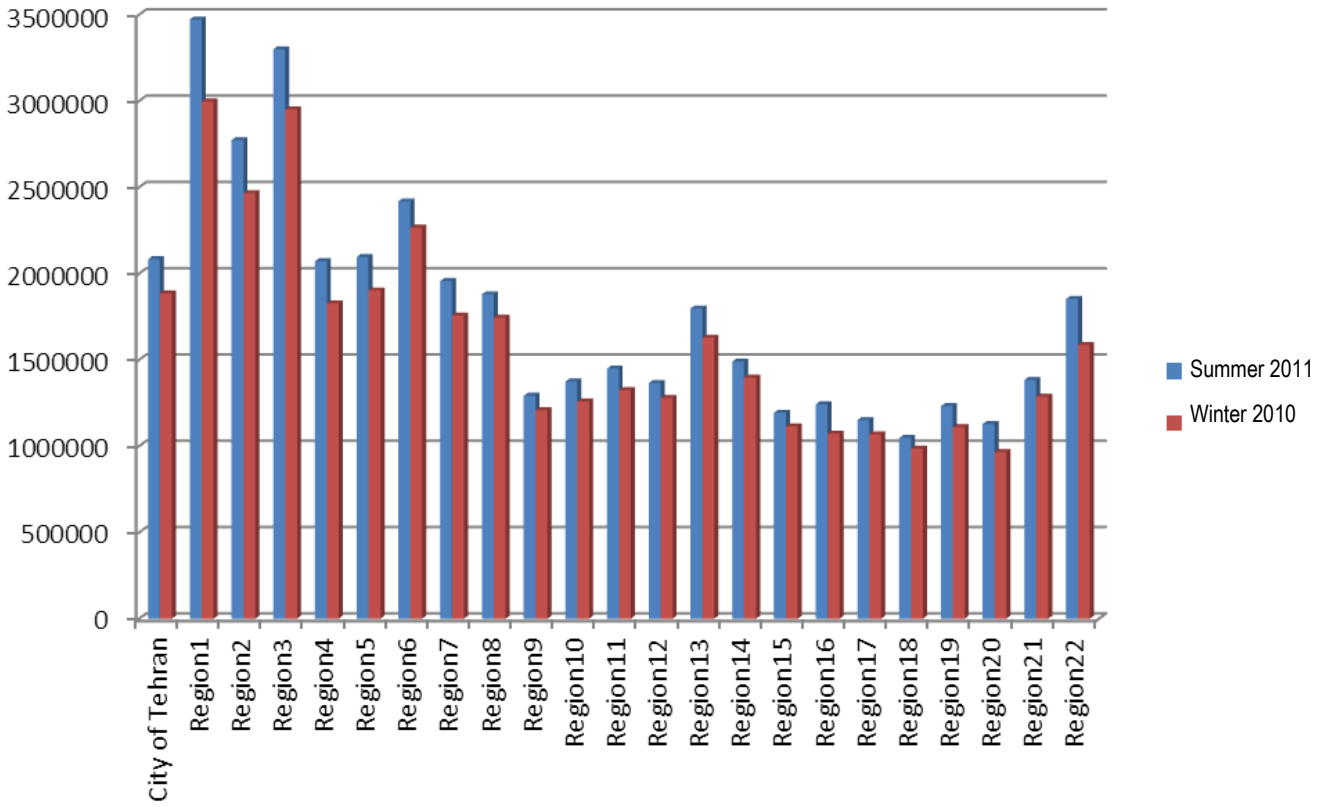
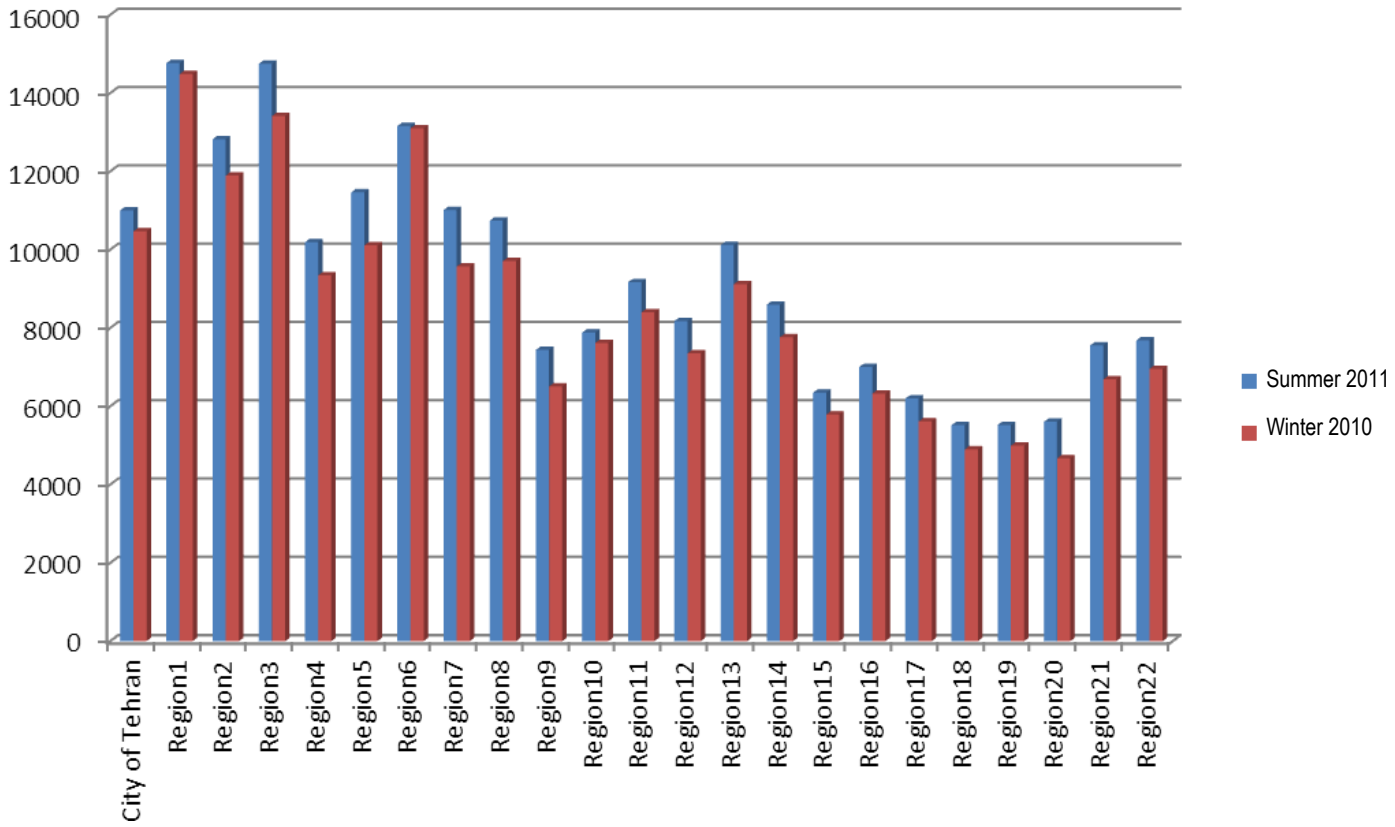


Figure 3.35: Mean square meter price/month of a rental residential property in differnet regions of Tehran during winter 2010 and summer 2011 (per Tomans)



Source of the three figures: The author using the data derived from Iranian Property & Tenement Data Management System, 2012

3.11 Spatial organization of Tehran

A large number of factors affect the spatial organization of the city and the distribution of activities, the most important of which are the environmental, historical, socio-economic, transportation, and economic structures. Wholesalers and retailers are mainly settled in the city center tending to spread towards the north. Public spaces have been formed alongside the commercial centers which themselves work as public spaces, where people walk, spend their time and do shopping. The most important centers of activity are located in the main commercial center of the city (Bazaar). Nevertheless, as shown in figure 3.36, there are a couple of other centers around the Tehran University in the center, Tajrish square and national exhibition in the north.

Figure 3.36: Spatial organization in terms of dominant administrative, commercial and service, 2006

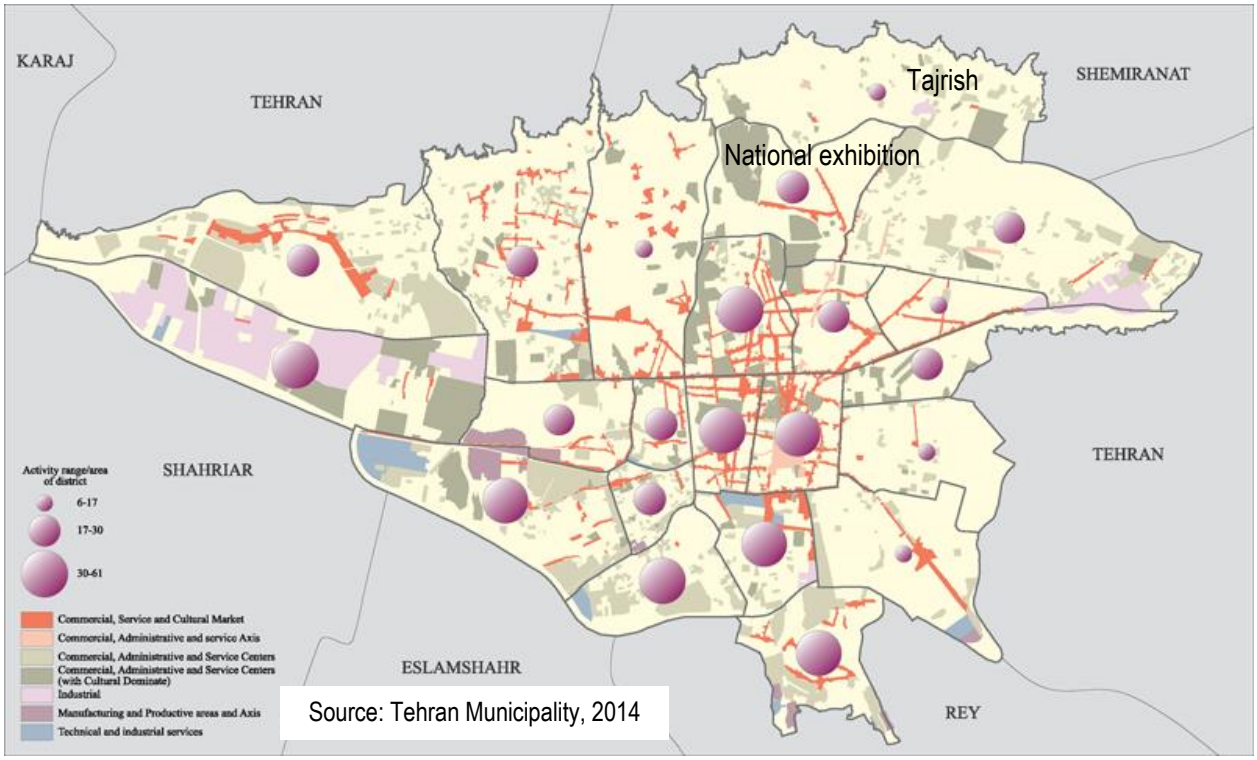


Figure 3.37: Enghelab Street, around Tehran University, center for bookstores

Enghelab Street, 1947

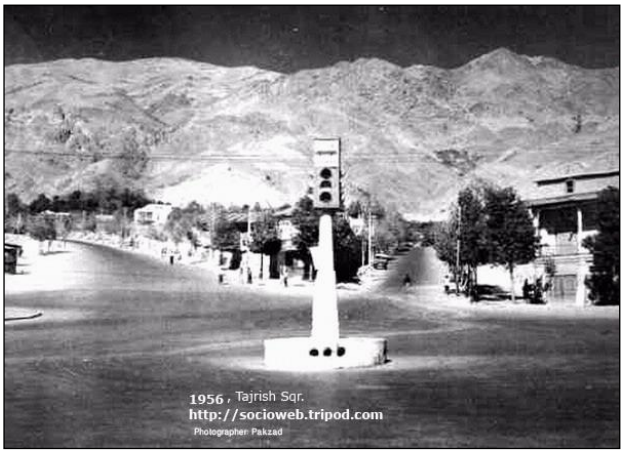
Enghelab Street or previous Shahreza Street

Enghelab Street- today

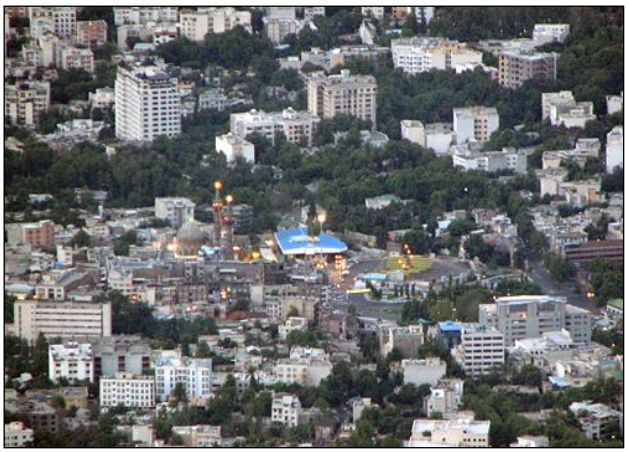
Enghelab Street– bookstore centers around university

Source: http:// farasarab.com- www.ista.com

Figure 3.38: Tajrish Square in1956 and present



Tajrish in 1956



Aerial photo- today

Source:

http:// socioweb.tripod.com-
www.danakhabar.com

Figure 2.39: National exhibition of Tehran- source: www.parsnews.ir

-Land use pattern of Tehran: As shown in figures 3.40- 3.43, the land use patterns and floor uses reflect the spatial organization of the city from a structural and legal perspective. A close examination of the land use map illustrates that residential land uses dominate others. Based on the data published by The Statistics Center in 2006, there are 2,205,304 residential units in Tehran, situated in an area of 177 sq. km, which is 28.8% of the total area of Tehran. Regions 10 and 14 show the highest values of residential land use and regions 9, 21, 19 and 22 the least. There are different types of units in residential land use. Valuable rural residential units include rural organic residential areas situated within the city limits, they are located in the villages of regions 1, 2 and 5. Valuable historical residential units comprise the residential units of old neighborhoods located mainly in Old Tehran, Rey and Tajrish. Valuable modern residential units are mainly found in Narmak and Charsad Dastgah (region 4), Ekbatan (region 5) and Shrake Gharb (Region 2) and include well- designed buildings or buildings which form dense neighborhoods. House gardens[1] include orchards and gardens used as residential units, also including the gardens of foreign embassies and those owned by the government. The greatest number of such gardens is located in region 1. Although they are considered as residential units, they are of the ecological value and consequently one of the subjects of the research. The ecological value stems from old, long local trees which are difficult to cultivate in Tehran's dry climate. In general, the greatest number of industrial units is found in regions 21, 18 and 20 which can be a big threat to the agricultural lands in these regions.

Table 3.4: The land use of Tehran

No.	Type of landuse	Occpied area (km^2)	Percent
1	Residential	117	28.8
2	Commercial-Administrative	26	4.2
3	Industrial- manufactury	27	4.4
4	Transportation &warehousing	30	4.9
5	Pass way& access network	114	18.6
6	Urban services	50	8.1
7	Green space	70	11.4
8	Agriculture	35	5.7
9	Military	44	7.2
10	Not built	41	6.7
Total		614	100

Source: Tehran Municipality, 2014

Lands reserved for urban services renovation are all large land parcels and estates with an area of one hectare and more, including fallow lands, open spaces, warehouses and old factories, they are the first choices for meeting the basic urban needs. These lands are primarily used for balancing out population settlement and urban services and, secondly for establishing buildings with new or multi-functional purposes and in response to future needs and plan. These estates have been defined in the comprehensive plan of Tehran as lands reserved for renovation of urban services. Tehran municipality uses these land reserves and estates as an attempt to intervene in the texture of the city and to introduce multi-functional urban services. The total of reserved lands and estates throughout Tehran sums up to 5000 hectares, with the largest part in Region 22 and the smallest in region 17. These lands can be considered as the available parcels with non-private ownership to enter TDR (Transferable Development Rights) function.

[1] House gardens are named in many urban literatures in Iran as "Residential- Garden".

Figure 3.40: Residential land use ratio in the regions of Tehran (2006)

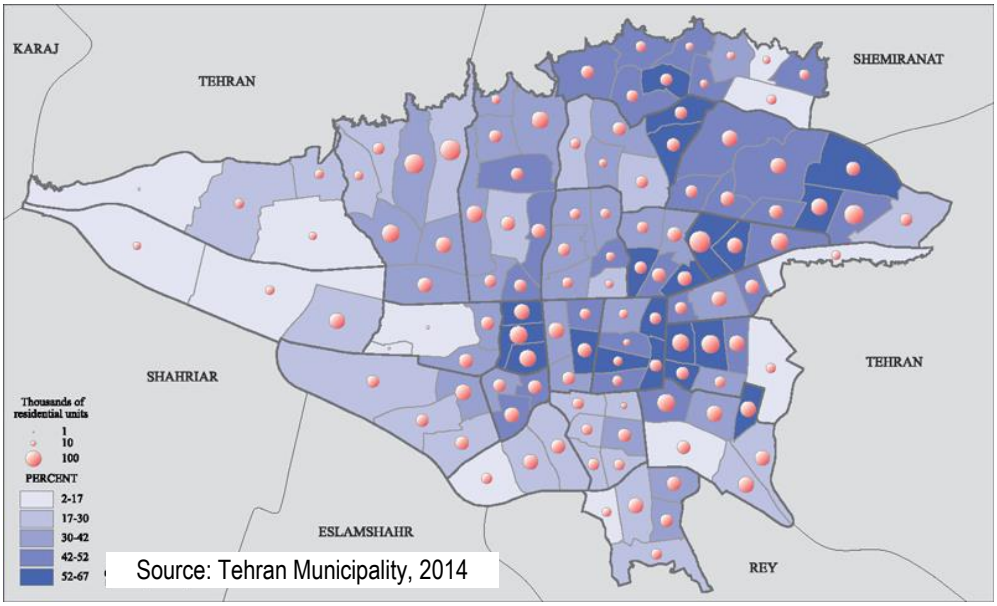


Figure 3.41: Commercial land use ratio in the regions of Tehran, 2006

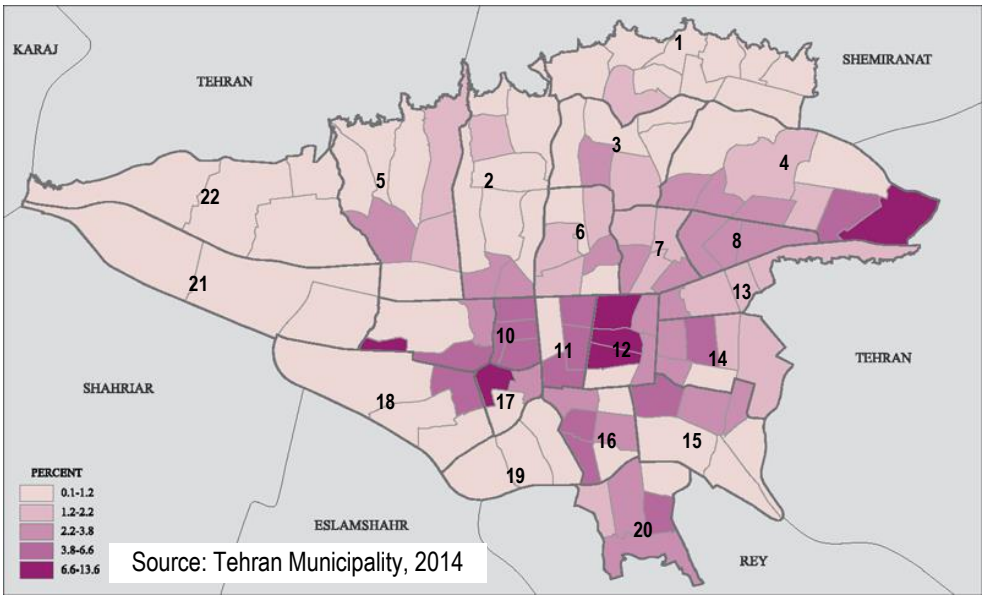


Figure 3.42: Amount and proportion of green spaces in forest parks and river valleys of each region (2006)

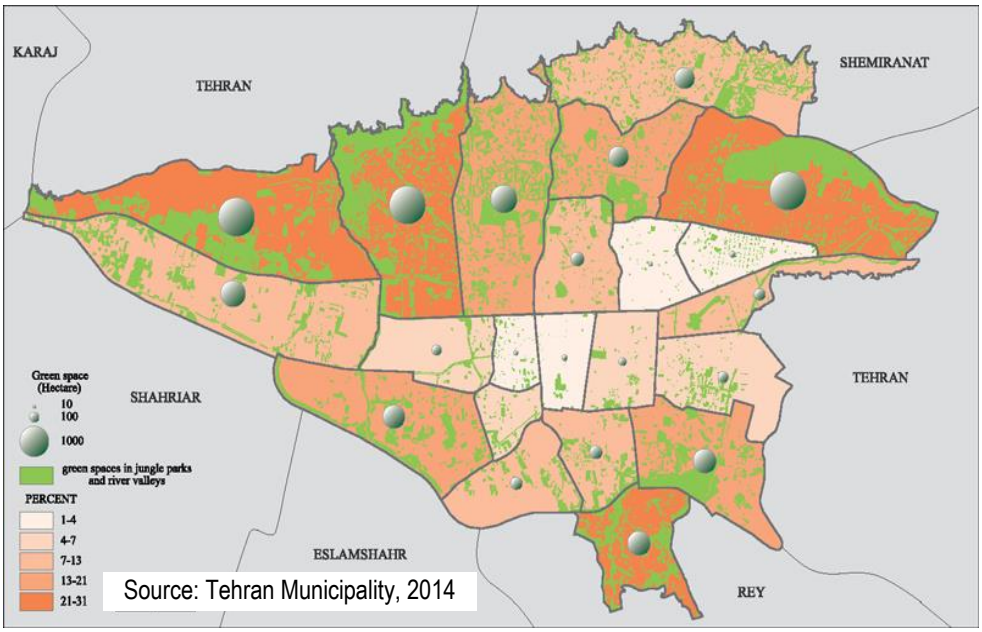


Figure 3.43: Population density and green space per capita

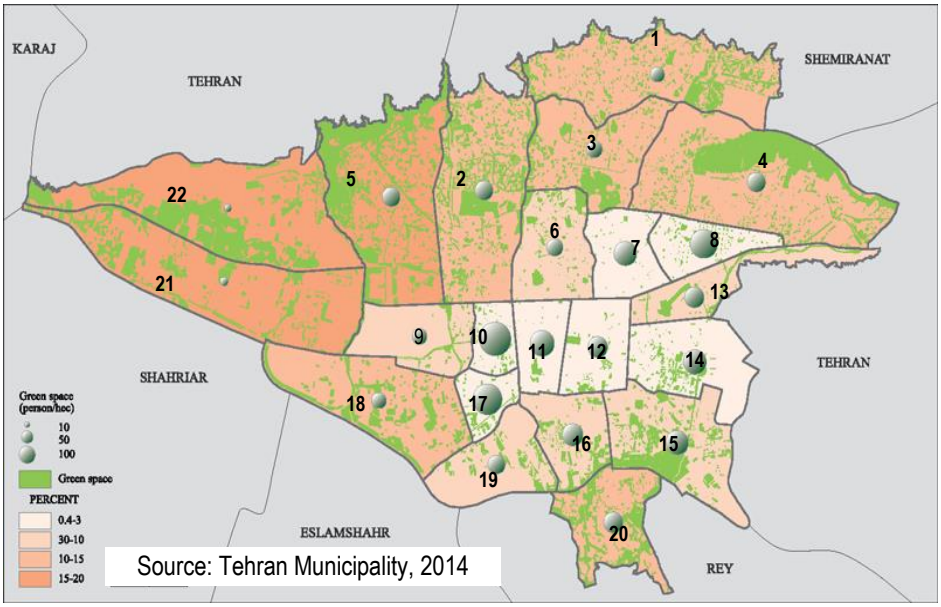


Figure 3.44: Ratio of urban reserve lands

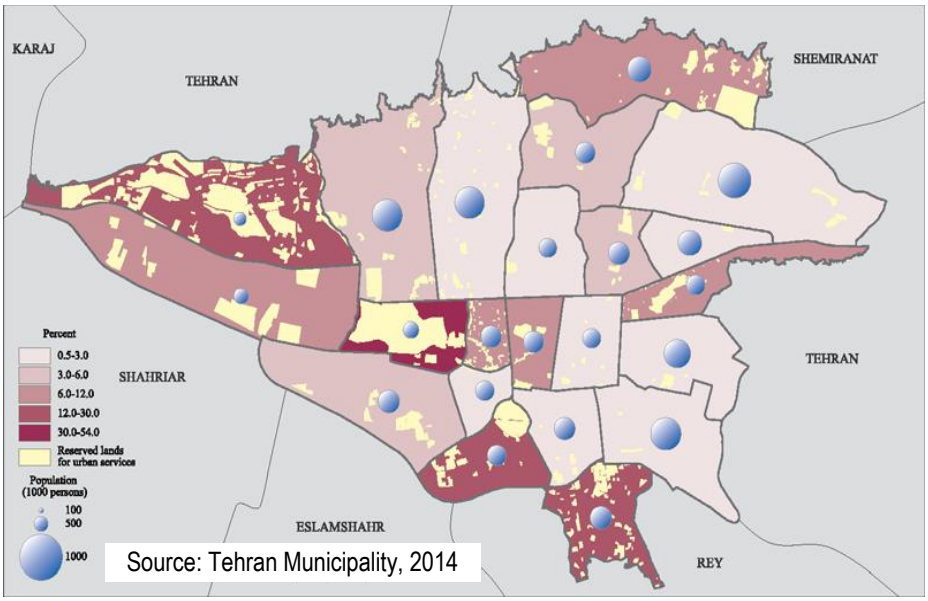
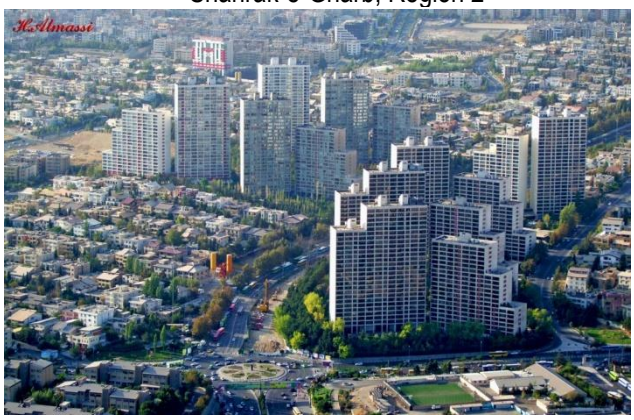


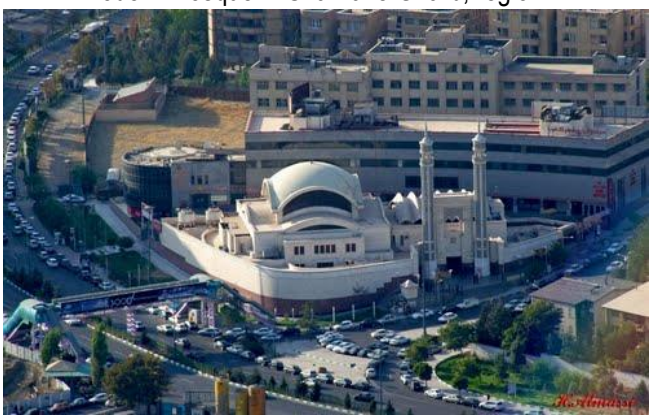
Figure 3.45: Ekbatan in region 5

Figure 3.46: Shahrake Gharb in Region 2, one of the modern residential regions of Tehran

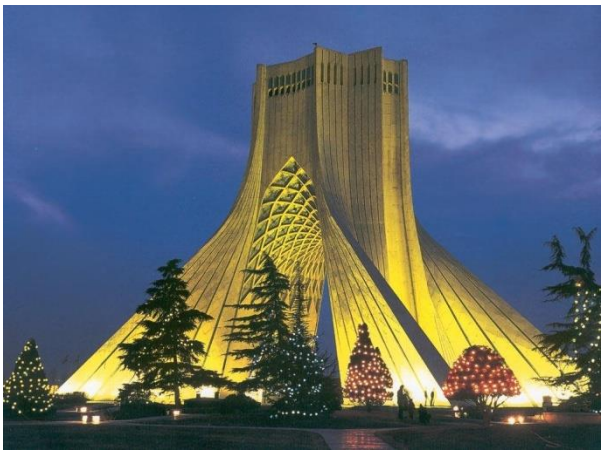
Shahrak-e-Gharb, Region 2



A modern mosque in Shahrake Gharb, region 2



Shahyad Square, the old symbol of Tehran, before revolution



Milad Tower, the new symbol of Tehran in Shahrak Gharb

Source: https://ssl.panoramio.com

-Recreational centers and parks: There are two kinds of parks in Tehran. Forest parks are used for long stays while urban parks are used for short stays, usually half a day. (Figure 3.47) Forest parks are usually located outside the city, urban ones within. Based on official statistics, there are nearly 750 operated parks inside Tehran, covering an area of 12,534,283 sq m. The parks in Tehran have been designed so that a maximum number of people can use them. But since certain parts of the city, especially the districts in the southwest, have so densely been populated, it is not possible to establish large parks there. That is why the majority of Tehran's large parks, especially forest parks, are located alongside motorways. The aim has been to offer easy access to green spaces. The majority of Tehran's large parks are located near two intersecting roads (north-south and east-west). This allows more people to have access to these parks via the metro or the motorways. However, according to European standards the park should be in walking distance to people.

Figure 3.47: Recreational centers and parks in Tehran

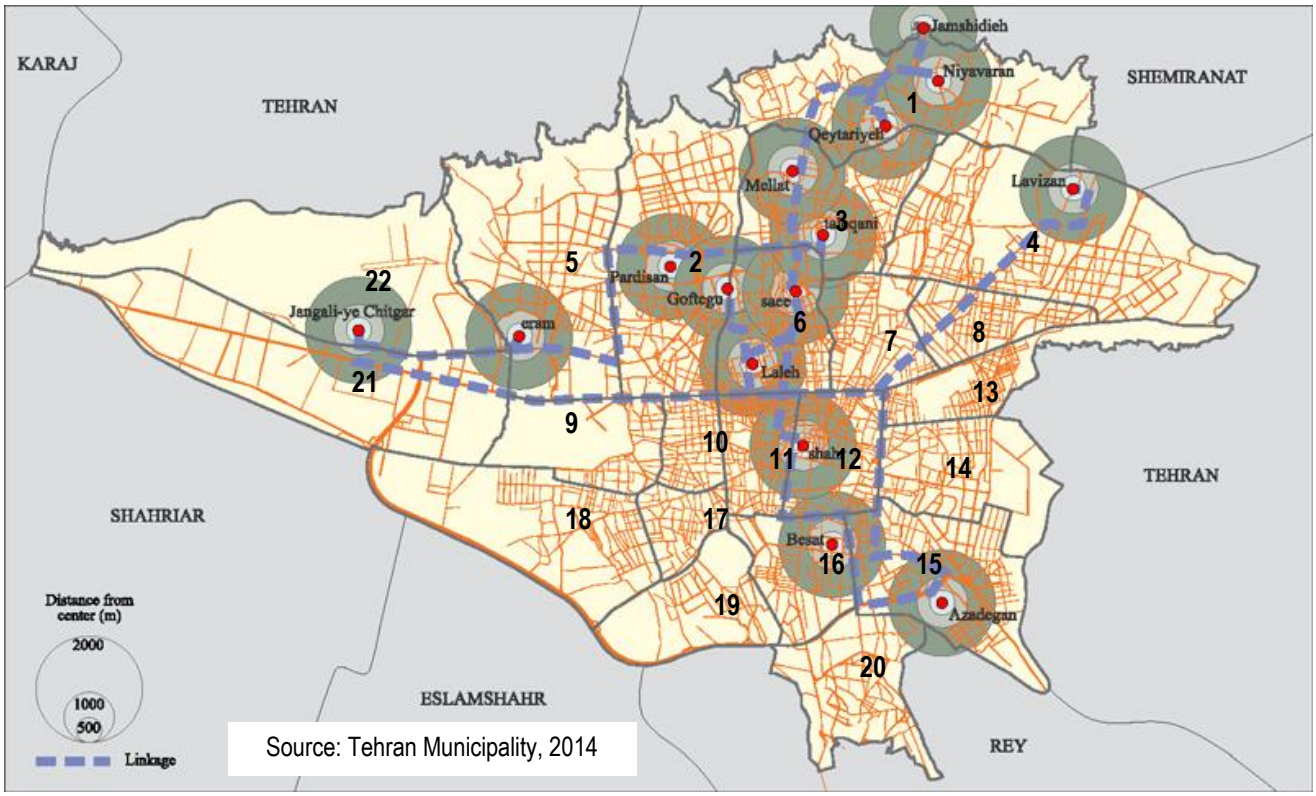
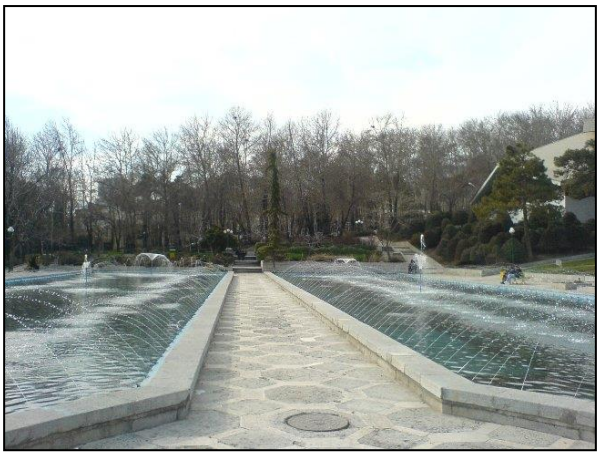


Figure 3.48: Mellat Park

Source: http://www.ahmadnia.net

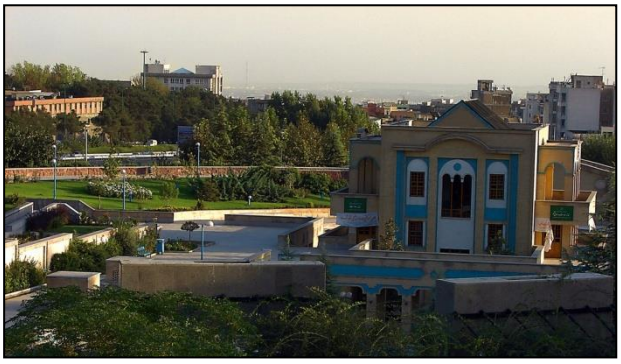
Figure 3.49: Parks in Tehran

Lavizan Park, Region 4

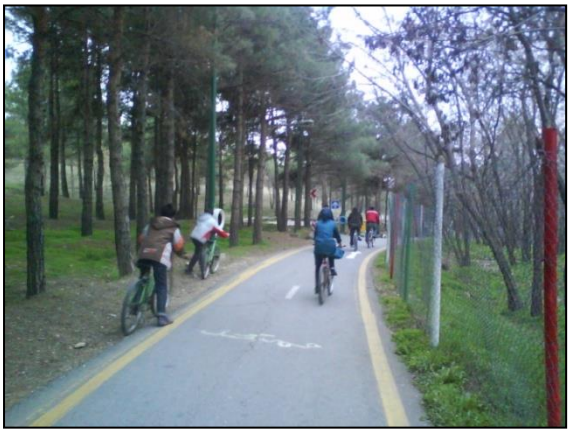


Niavaran Park, Region 1

Goftegoo Park, Region 2



Shar Park, Region 12



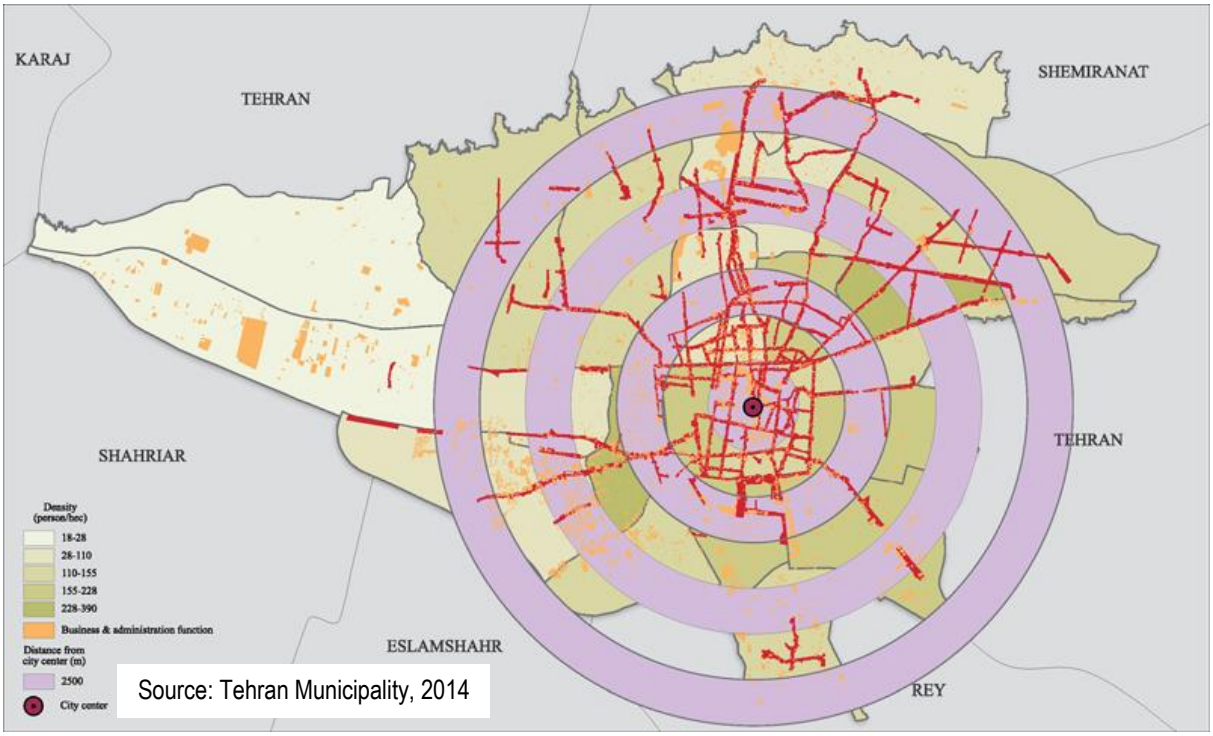
Chitgar Park, Region 22

Azadegan Park, Region 15

Gheitariye Park, Region 1

- The Central Business District (CBD): Tehran's CBD is mainly formed in the center of the city along the main streets. The spatial characteristics of the city and its historical development process have caused Tehran, like many other cities in the world, to experience changes in the settlement of population and activity centers. The center of the city has been witnessing a decrease in population and an increase in service activities. If we assume concentric circles around the city center (Figure 3.50), the central circle, where historical buildings are situated, is dominated by commercial functions, and the middle circle is characterized by residential, commercial, and cultural functions, with industrial functions occurring in the southern parts. The outer circle includes newly developed spaces characterized by open and public urban spaces and less densely populated areas. However, with the emergence of new forms of business and modern companies, business activities expanded first into the immediate northern areas of the traditional bazaar and developed into the eastern and western areas and then into the newly developed areas toward the northern sections of the city center. This model can be compared to two urban structure models explained below:

Figure 3.50: The Structure of business & administration function & population density & distance from city center (2006)



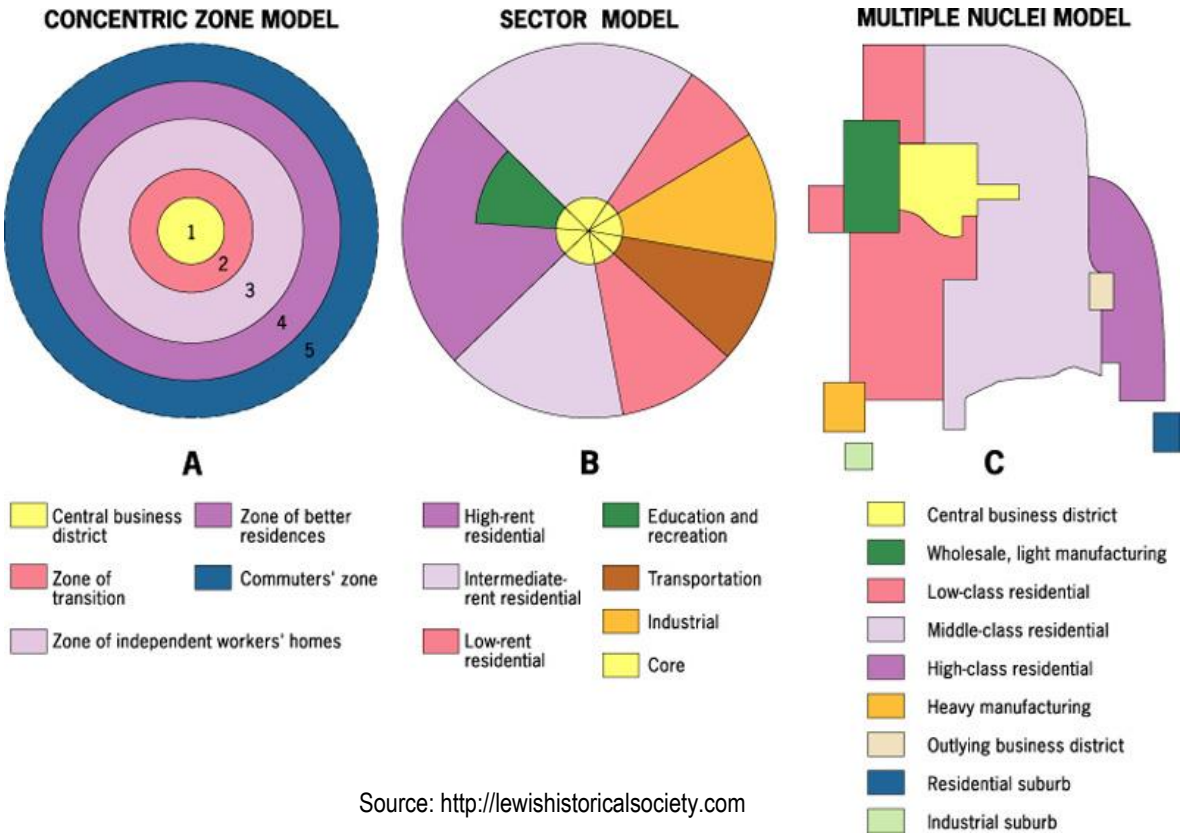
Source: Tehran Municipality, 2014

Since the general patterns of city structure were described by Burgess in 1925 and 1929 (figure 3.51-A) and also Hyot (figure 3.51-B) in 1939, there has been a tremendous growth of population throughout the world and Hyot tries to describe how much this factor of growth changed the form of change of urban communities. Burgess concentric circle theory was based on a study of Chicago and he made a brilliant and vivid contribution to urban sociology and geography which inspired Hoyt later (Hoyt, 1964, p.199). As shown below the inner part of the city is Central Business District and more distance from this part indicates the better economic status of the householders. The last circle is mainly high class and expensive housing in a rural, suburbanized setting. The commuting costs are the highest. Prior to mass diffusion of the automobile (1930s), most of these settlements were located next to rail stations.

The earliest constructive criticism of Burgess's model emerged from an analysis of the internal residential structure of 142 American cities by Hoyt who concluded that the general spatial arrangement was characterized better by sectors than concentric zones. He starts with the assumption that a mix of urban land uses will develop around the city center, then, as the city expands, each will extend outwards in a sector. In this manner the high-rent neighborhoods of the wealthy follow a definite path along communication lines, on high ground free from flood danger, towards open country, or along lake or river fronts not used by industry. Conversely, low- incomes

groups with limited housing choice consume the obsolete housing of the wealthy, now converted into apartments, or occupy less desirable zones (Pacione, 2005, p.144).

Figure 3.51: Burgess, Hoyt and Harris urban land use models



Source: http://lewishistoricalsociety.com

The theory is based on early twentieth century rail transport and does not make allowances for private cars that enable commuting from cheaper land outside city boundaries (Rodwin, 1950, p.299). “A major contrast between the models of Burgess and Hoyt is that whereas residential change is simulated on the demand side in Burgess’s model, with immigrants competing for inner-city housing, Hoyt stresses supply- side mechanisms, with the concentration on new housing for middle classes on urban periphery being the catalyst for socio-spatial change. Hoyt’s model does not replace the concentric-zone scheme but extends it by adding the concept of direction to that of distance from the city center” (Pacione, 2005, p.144).

Tehran development model can be compared with these two models and is a combination of the two. As described in the both models there is a CBD in the core center of Tehran with the commercial function. The middle circle in Tehran is residential but not in all the parts; the southern parts are more industrial. This can be compared with second, third and forth circle in Burgess’s model which are factory, transition and working class zone. The difference is that in Tehran these zones have been distributed in the second circle. The south part of the circle is similar to the second zone of Burgess and there is a transition zone followed by residential land use in different parts of the circle.

However, simultaneously there are sectors of development as explained in Hoyt model. The expansion of Tehran in the first comprehensive plan was considered according to Tehran topography as north-south by Farmanfarmayan in 1963 urban team but later with East-west motorways and tunnels to lose the traffic problems, this expansion was redirected by new planners. These two happenings made sectors of communication and the population has been transferred along these two channels. In addition many new urban services and commercial corridors emerged in the direction to north in contrary to Master plan in 1991. Parallel to these sectors there is a transition social class layer as described in Hoyt model. They can be low-income class to middle, depending on how far they are from the main CBD. This means that the further we go from CBD to north, the higher the socio-

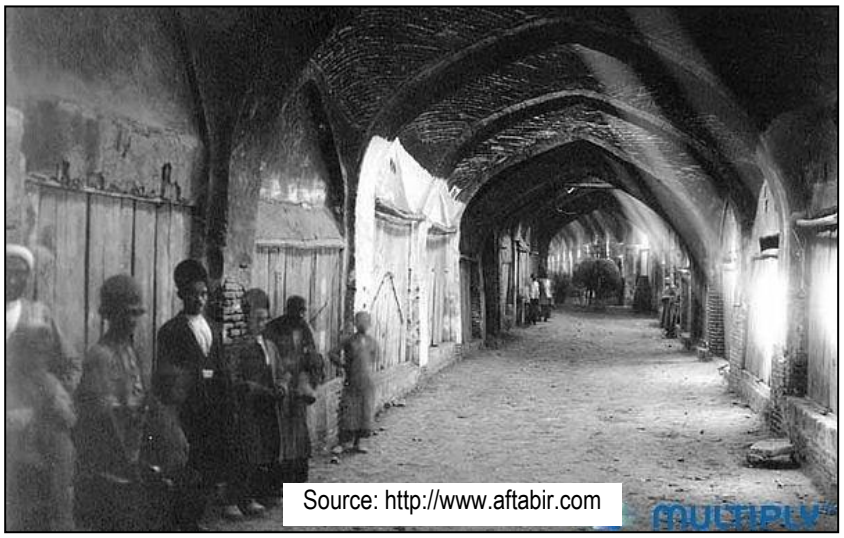
economic class becomes and the longer the distance from CBD to the south, the more lower-income residents becomes present. The last circle which is newly developed areas with more open space has two different parts itself; the southern parts are more immigrants from other cities or previous farmers and the northern parts are mostly high- educated upper middle to high class level of Tehran. This is exactly zone 5 and 6 in Burgess's model with southern and northern sectors of Hoyt's model.

Tehran expansion has been so complicated and unplanned in a period of time that it can be also similar to "Multiple Nuclei Model" in figure 3.51-C. The model is an economical model created by Chauncy Harris and Edward Ullman in the 1945 article "The Nature of Cities". The model describes the layout of a city. It says that even though a city may have begun with a central business district, or CBD, other smaller CBDs develop on the outskirts of the city near the more valuable housing areas to allow shorter commutes from the outskirts of the city. This creates nodes or nuclei in other parts of the city besides the CBD thus the name multiple nuclei model. Their aim was to produce a more realistic, if more complicated, model. Their main goals in this were to:

1. Move away from the concentric zone model
2. To better reflect the complex nature of urban areas, especially those of larger size

If we shift this model 90 degrees counter clock-wise and then complete the southern parts of the city with the same low- class residential and industrial regions, the outcome model can be very similar to Tehran. Therefore Tehran model can be considered as a combination of Burgess and Loyt theories and a completion of Harris and Edward'd model.

Figure 3.52: Tehran Bazzar in Ghajar dynasty (1785 to 1925) and today



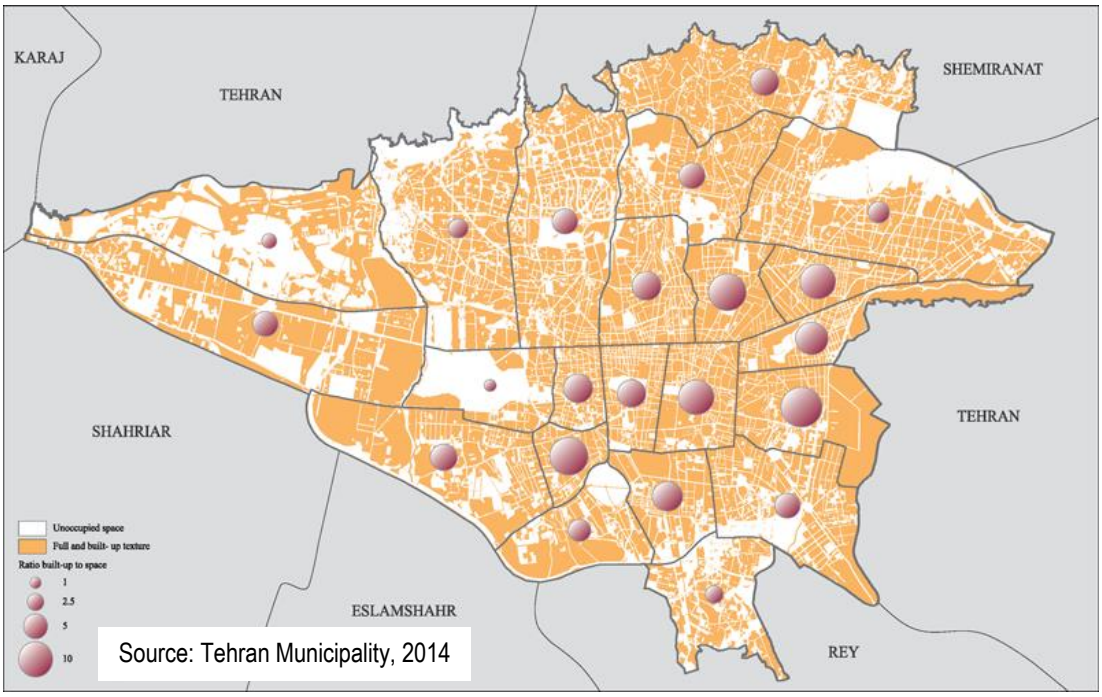
Source: http://www.aftabir.com

http://www.iranreview.org

- System of built up and open spaces: The structural organization of the city is defined by two main elements in the fabric of the city, i.e. open and built up spaces. (Figure 3.53) The most important of these factors are the regulations concerning the macro level control of the urban design programs, which affect the overall spatial organization of the city as well as the quantity and quality of its construction activities, the emerging proportion of the built area to available space, and the quality of its visual corridors and city vistas. Interestingly, the condition of construction and its relation to open space as well as the proportion of open and built spaces differ in various districts of the city. The open and public spaces of the city can be divided to three groups: The first one are formed by green spaces (including urban parks, urban forest, farmlands, gardens and orchards) whereas the second comprises roads and accesses (including highways, major and minor streets and road lanes), and reserve lands of urban services (including old factories, warehouses and uncultivated lands) fall into the third category.

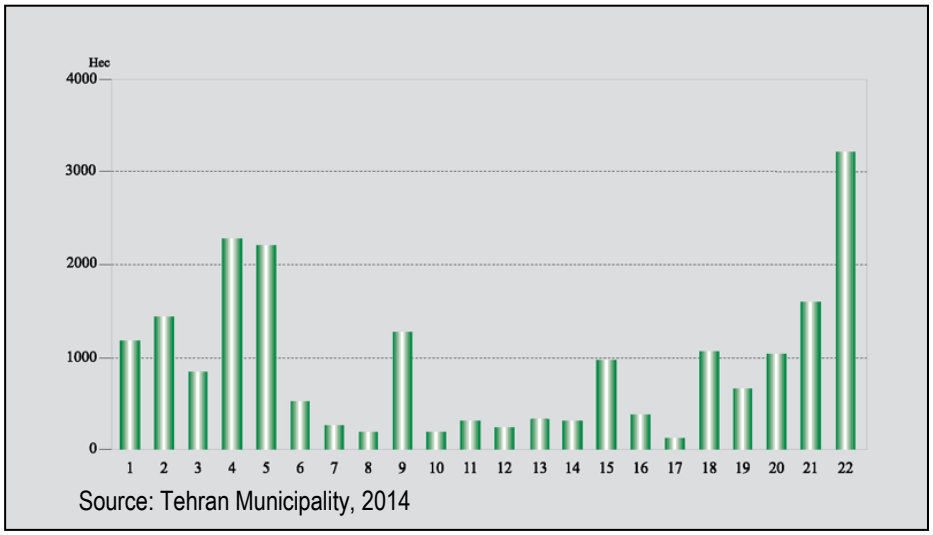
The central part of Tehran and the southern half of the city are densely populated due to the small size of the residential units. The density in this region is almost twice as high as the average density of Tehran. Region 22 has the most and regions 7, 8 and 17 have the least open and public spaces. (Figure 3.54) In the regions 14, 7, 8 and 17 and 12 the area devoted to buildings is by far greater than the area devoted to public and open spaces (Figure 3.55 and Table 3.5).

Figure 3.53: Situation and degree of full and built-up textures of Tehran (2006)



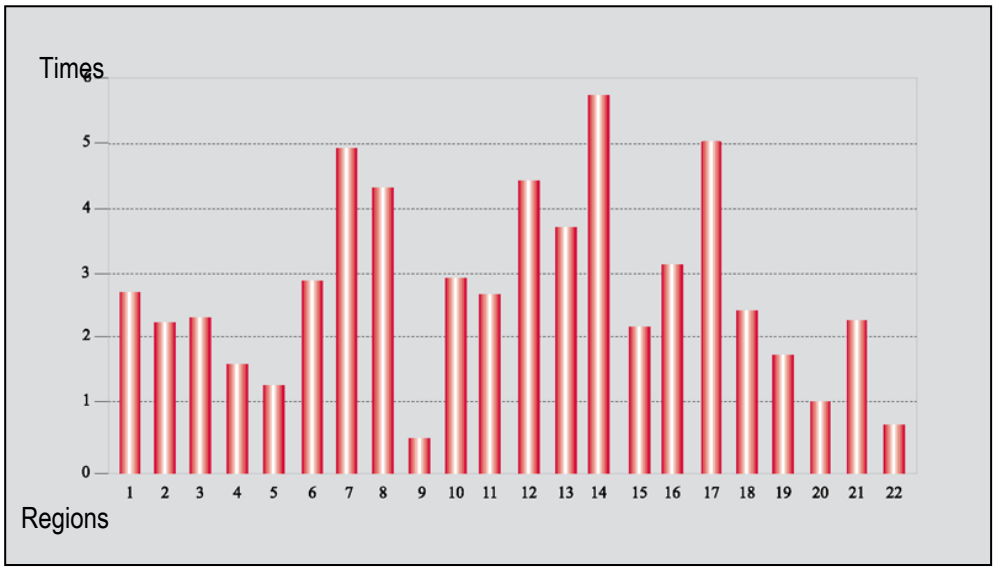
Source: Tehran Municipality, 2014

Figure 3.54: Open public spaces, green spaces and streets in different regions of Tehran (2006)



Source: Tehran Municipality, 2014

Figure 3.55: Ratio of built-up to open and public spaces in different regions of Tehran (2006)



Source: Tehran Municipality edited by the author, 2014

Table 3.5: Green spaces, public spaces and streets compared with built-up areas in Tehran's regions

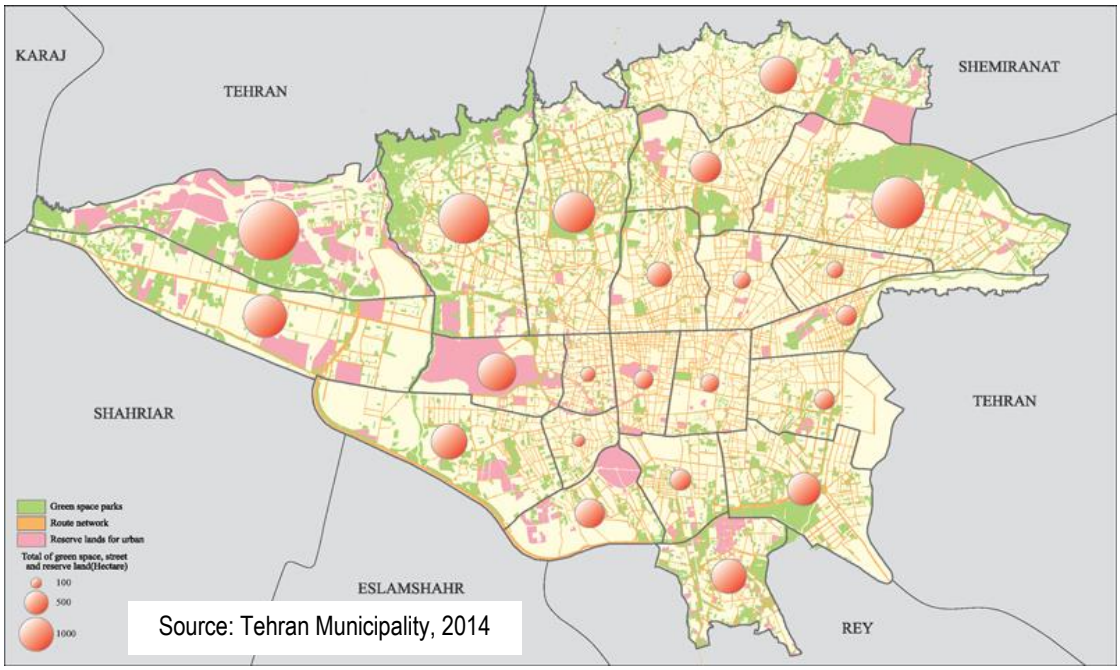
Region	Area	Built-up areas		Open spaces		Built/ open ratio	Region	Area	Built-up areas		Open spaces		Built/ open ratio
		hectare	percent	hectare	percent				hectare	percent	hectare	percent	
1	4574	3388	74.1	1186	25.9	2.9	12	1601	1313	82.0	288	18.0	4.6
2	4761	3341	70.2	1420	29.8	2.4	13	1700	1349	79.4	351	20.6	3.8
3	2938	2095	71.3	844	28.7	2.5	14	2412	2064	85.6	348	14.4	5.9
4	6160	3884	63.0	2277	37.0	1.7	15	3130	2182	69.7	948	30.3	2.3
5	5322	3118	58.6	2204	41.4	1.4	16	1652	1265	76.5	388	23.5	3.3
6	2141	1611	75.2	531	24.8	3.0	17	822	689	83.8	133	16.2	5.2
7	1537	1284	83.6	252	16.4	5.1	18	3808	2744	72.1	1064	27.9	2.6
8	1322	1081	81.8	241	18.2	4.5	19	2053	1334	65.0	719	35.0	1.9
9	1951	698	35.8	1253	64.2	0.6	20	2255	1208	53.6	1047	46.4	1.2
10	807	609	754	198	24.6	3.1	21	5550	3923	70.7	1627	29.3	2.4
11	1205	889	73.8	316	26.2	2.8	22	5851	2580	44.1	3271	55.9	0.8

Source: after Tehran Municipality, 2014

Open public spaces: Open, green and public spaces are not evenly distributed among all districts in Tehran. This is due to the historical development of the city, the established patterns of available open urban spaces, and the distribution of industrial, military and services sectors in the various districts of the city. Unlike central districts, the districts on the urban periphery have a better situation. Also based on this criterion (being located on the urban periphery) regions of 22, 5 and 20 have the highest ranking in open green space, followed by regions 21, 4 and 9.

This ratio (Table 3.5) will be discussed in further chapters in Essen and European cities. In the city of Essen in Germany this has been tried to be kept up to 1 which means 50% of each built-up areas and open space. There have been always problems and discussions about these calculations between urban planners. The most important point to make is that in all calculations the exact definition of each category has to be given so that it is clear for everyone what exactly has been considered as open space or green land and public space. In some calculation streets are calculated and public space and in other as open space. Whereas many urban planners consider public space as a part of open space.

Figure 3.56: Situation and degree of public open spaces in the areas (2006)



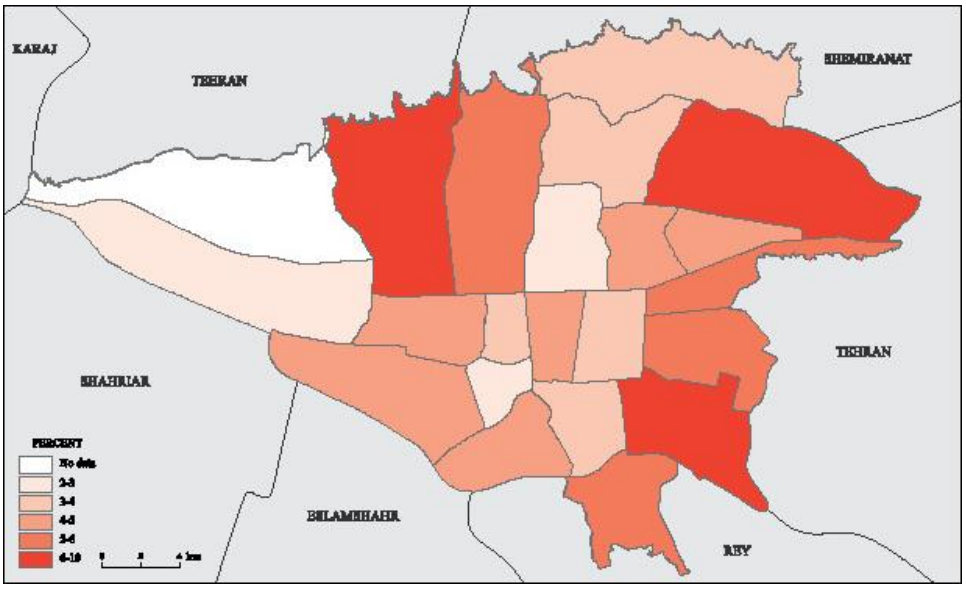
-Typology of urban textures: A general survey of the historical development of the city, an examination of the building licenses issued within the last decades, and the number of residential units built in each district makes it possible to identify three types of areas: old, relatively new and newly built. Figure 3.58 shows the years of the building permits. In the last several decades, the production of housing has occurred unevenly among the districts of the city. The northwestern, eastern and southwestern districts have shown the largest and the most varied development. A study of the construction licenses issued from 2006 to 2010 shows that the largest number of buildings has been constructed in districts 2 and 5 (in the northwest), in regions 8 and 4 (in the northeast), in region 18 in the southwest and in regions 14, 15, and 5 (in the southeast).

Figure 3.57: Construction in the middle of green lands in region 1 and 18 of Tehran

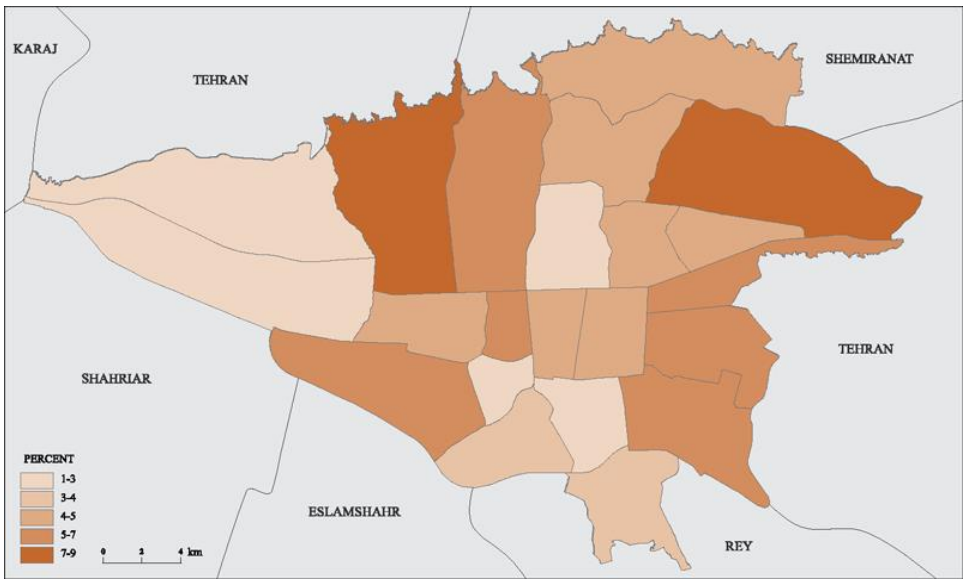
Source: Baft-e- Shahr Consulting Company, 2010

Figure 3.58: Building Permits issued in the regions of Tehran

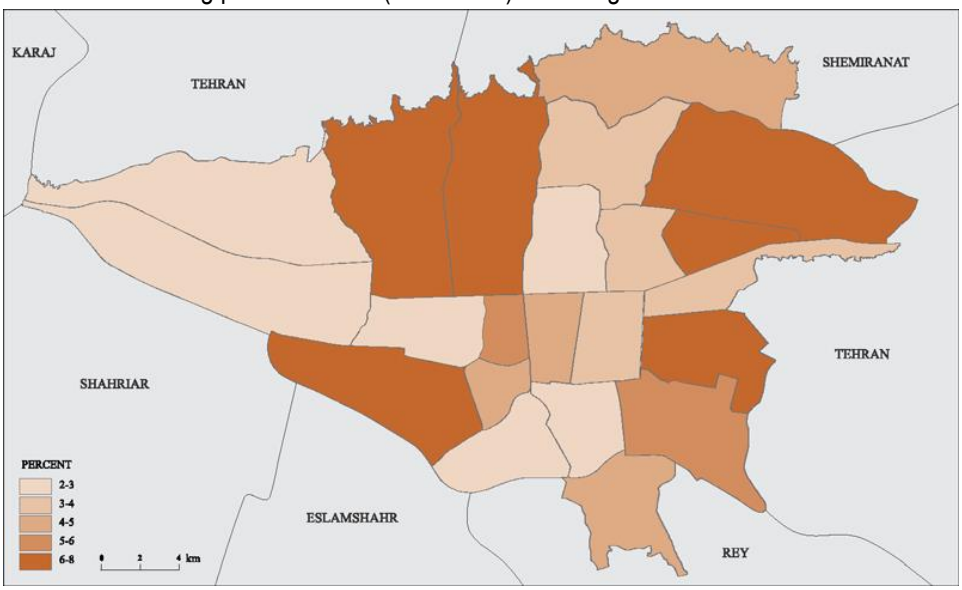
Building permits issued (1995-2000) in the region of Tehran



Building permits issued (2001-2006) in the regions of Tehran

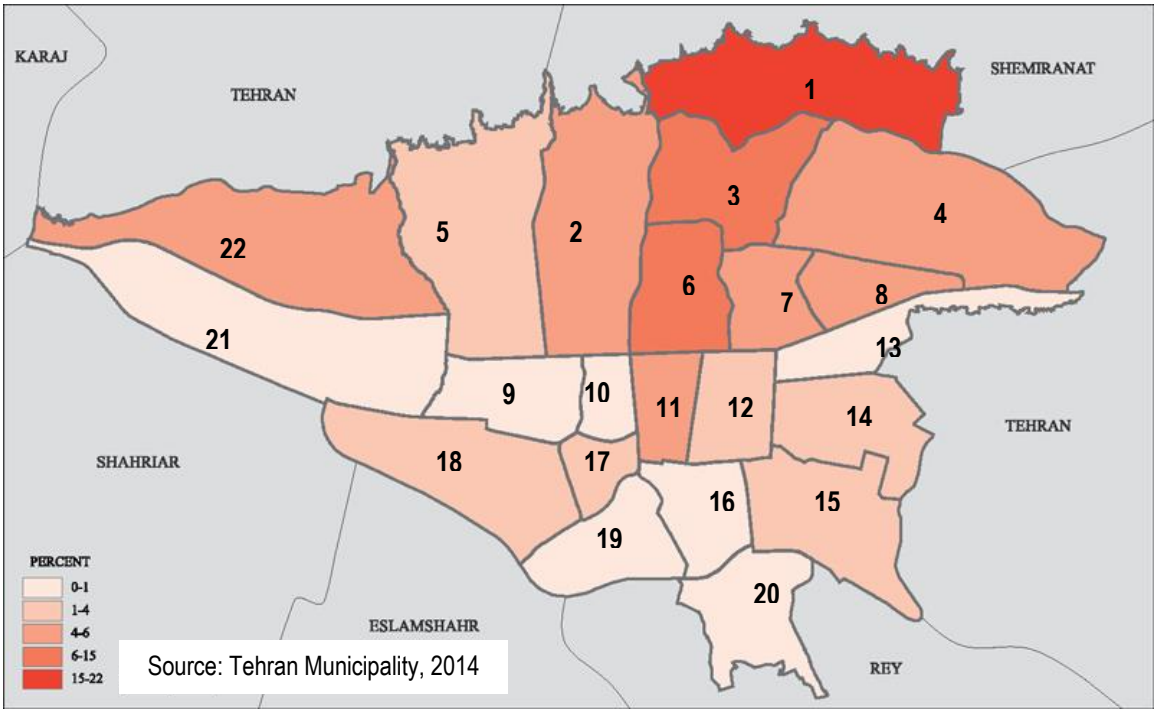


Building permits issued (2006-2010) in the regions of Tehran



Source: Tehran Municipality, 2014

Figure 3.59: Permit issued for building over 10 floors (2000-2001)



The spatial distribution of licenses for the construction of buildings of over 10 floors issued between 2000 and 2009 (Figure 3.59) shows that most of these buildings have been constructed in district 1, followed by regions 3, 6, 8, 7, 4, 2 and 22. This distribution clearly shows that certain regions have a higher residential-economic value, with the highest values are found in region 1 or, in general, in the northern half of the city (excluding region 5). This is particularly reflected by the main northern-southern axis comprising regions 6, 3, 1 and 11. Obviously, construction investments in these regions result in a higher added value. High topography, nice ecological conditions and good weather absorbed the population in the very beginning to the northern regions but now the economic status of the regions has been so strong that it is destroying the initial reasons of the popularity of this area. High-rises are the symbols of power and money which are destructing the unique ecological character which was the only reasons many residents move to the north. Therefore, during the time ecological values have been substituted by economic values and the new values build a new character for the regions.

Figure 3.60: High-rises in region 1 of Tehran

- Historical valuable areas: The historical places of Tehran are illustrated in figure 3.61. It includes old Tehran, historic Tehran, Historic-religious Ray and Tajrish and Saadabad. The last group is combined with the gardens as it comprises the old palaces or old villas of the north of Tehran. This proves that the gardens of this region 1 do not only have ecological value, they are also a part of Tehran's heritage.

Figure 3.61: The proportion of valuable historical texture (2006)

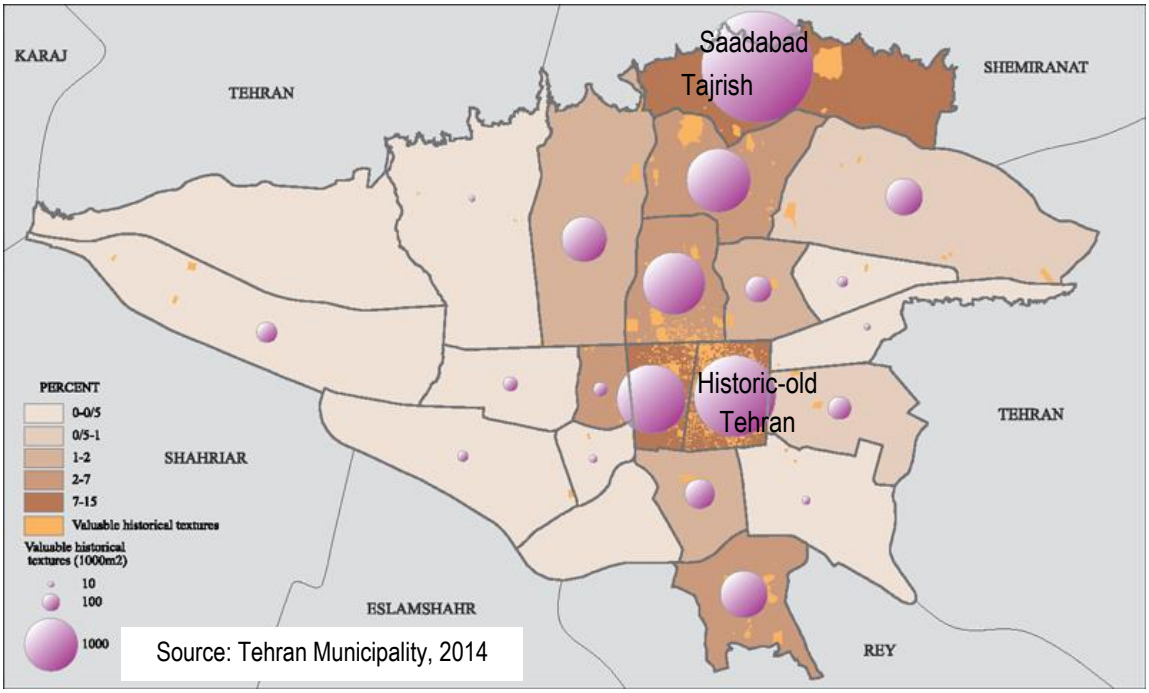
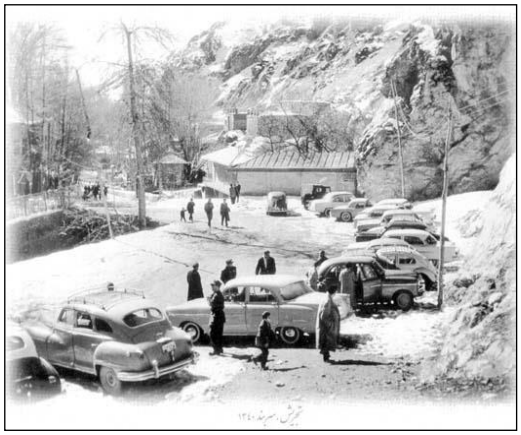


Figure 3.62: Old Tehran, Source: http://www.iranianhotline.com

Sepah square, Region 12, Source: www.iichs.org/magazine



Tajrish- Sareband, Region1, 1961

Tajrish- Sareband, Region1, 2010

Source: http://www.iranianhotline.com

- Valuable rural texture: The valuable rural texture includes residential areas with an organic structure, currently located within the city limits. Although these textures are highly vulnerable and inefficient in terms of urban use, it is important to keep them in order to enhance the memory and identity. The total area of these villages is 385 hectares, i.e.1.4% of the total residential area. At present, due to a non-systematic pattern of construction, these areas are facing two challenges, the loss of identity and the loss of tranquility. Traffic is increasing in these neighborhoods and the streets are getting more and more insecure; there is a lack of adequate paved streets leading to local centers for social interactions, and a lack of urban facilities for services. As shown in table 3.6 and figure 3.63 regions 1, 5 and 21 have the greatest number of rural buildings, in comparison to other districts.

Table 3.6: The area of valuable rural textures

District	Area of valuable rural texture (hectares)	percent
10	8.8	2.3
3	22.4	5.8
2	43.7	11.4
1	73.6	19.0
21	113.0	29.4
5	123.6	32.1
Total	385.1	100

Source: Tehran Municipality, 2014

Figure 3.63: The proportion of valuable rural texture (2006)

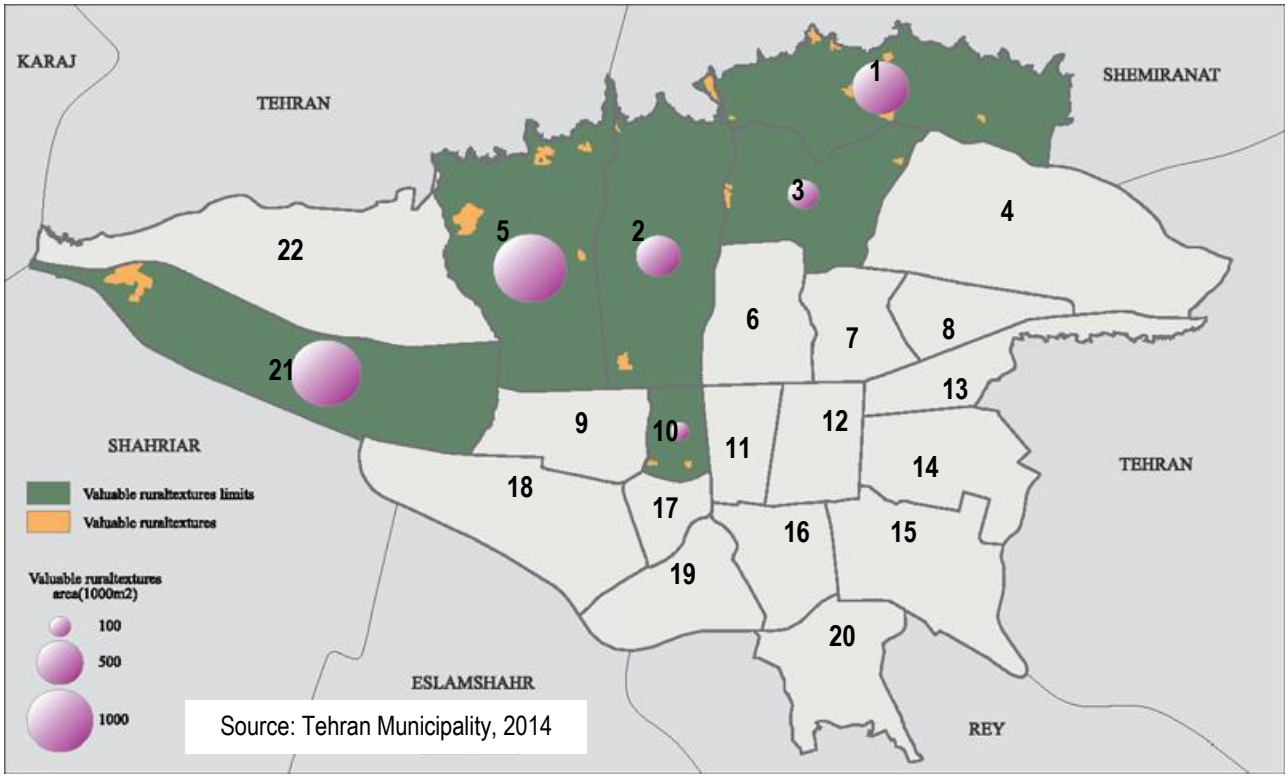
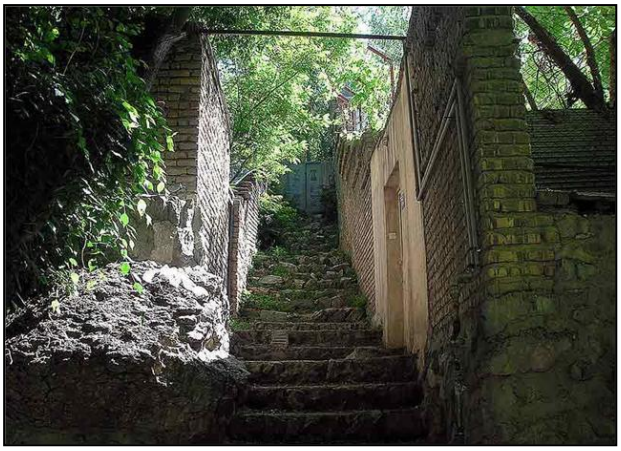


Figure 3.64: Valuable rural texture

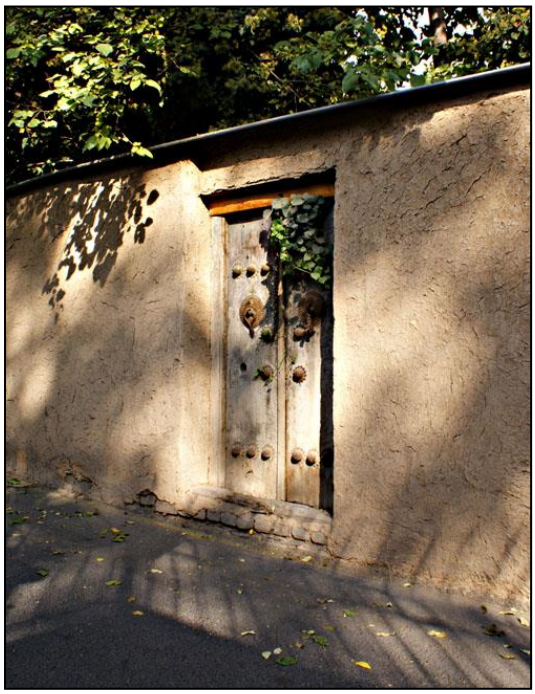
Kaan rural texture- Region 5



Farahzad rural texture- Region 5

Darband rural texture- Region 1

Golabdarre rural texture- Region 1



Deh Vanak rural texture- Region 3

Twin waterfall- Region 1

Source: http://shahrmajazi.com

3.12 Climate Change

Before analyzing the climate change in Tehran, it is necessary to have a close look at the status of Iran within the global climate change.

3.12.1 Climate change in Iran

The Climate Change Performance Index (CCPI) is an instrument that enhances transparency in international climate politics presented by Germanwatch and the Climate Action Network Europe each year. On the basis of standardized criteria, the index evaluates and compares the climate protection performance of 57 countries that, together, are responsible for more than 90 percent of global energy-related CO_2 emissions. Eighty percent of the evaluation is based on objective indicators of emission trends and emission levels. It is the aim of the index to encourage political and social pressure on those countries which have, up to now, failed to take the initiative on climate protection or which still neglect the importance of this issue (CCPI, results of 2011, p.5). The climate change performance index for different years will be reviewed here to highlight the status of Iran and the necessity of this research as a scientific step which attempts to improve the situation in this country.

"The poor performance of most of the ten largest CO_2 emitters (Table 3.7) is particularly alarming. These countries account for more than 60 percent of global CO_2 emissions. Therefore, their future willingness and ability to pursue a sustainable climate policy is a requirement to avoid a highly dangerous level of climate change (CCPI, results of 2011, p.6)." As shown in the table, Iran is one of the very poor performing countries and the very poor CCPI rank of 52 deteriorated even since 2010.

Table 3.7: Key data for the 10 largest CO_2 emitters

Country	CCPI Rank 2011	(2010)	Share of Global CO_2 Emissions*	Share of Global Primary Energy Supply	Share of Global GDP	Share of Global Population
Germany	7	(7)	2.74%	2.73%	3.68%	1.23%
United Kingdom	8	(6)	1.74%	1.70%	2.88%	0.92%
India	10	(9)	4.86%	5.06%	6.75%	17.05%
Korea, Rep.	34	(41)	1.71%	1.85%	1.78%	0.73%
Japan	38	(35)	3.92%	4.04%	5.63%	1.91%
Russia	48	(45)	5.42%	5.60%	2.59%	2.12%
Iran	52	(38)	1.72%	1.65%	0.92%	1.08%
USA	54	(53)	19.05%	18.62%	18.39%	4.55%
China	56	(52)	22.29%	17.37%	17.31%	19.93%
Canada	57	(59)	1.88%	2.17%	1.64%	0.50%
Total			65.33%	60.79%	61.57%	50.02%

*energy related

© Germanwatch 2010

Rating: Very good, Good, Moderate, Poor, Very poor

Source: Climate change performance index, results of 2011, p.7

Here Iran climate change status in the last years by using maps and tables from CCPI will be briefly reviewed to see if any progress has been made. In 2008 Iran ranked 34 in the overall results of climate change performance index as shown in table 3.8 and in a poor condition as presented in figure 3.65. The Index only takes energy-related emissions into account. Thus, all countries with an emission share from land-use change higher than 10% (hatched countries in the map) have a special responsibility additionally to reduce their emissions in this sector. Especially Brazil (share of 80%) and Indonesia (share of 45%) have to be supported in their efforts.

In 2009 Iran went 5 steps backward and achieved only the 39th rank. Whereas in 2010 Iran has made one step further to 38th rank with the score of 49.2 but still, the overall status is "poor" compared to other countries.

According to mentioned table and figure in 2011 Iran dropped dramatically to position 52 and to a "very poor" performance. The emissions trend is an important indicator within the CCPI, as it composes 50 percent of the

weight of the ranking. Conversely, Saudi Arabia, Australia and Iran have the worst emissions trends measured over the last five years. Again in 2012, Iran experienced a worse position at CCPI with the 60th rank, a situation that remained the same in 2013.

Table 3.8: Overall results of climate change performance index in 2008 (left side) 2011 (in the middle) and 2013 (right side)

CCPI Rank	Country	Score*	Partial Score Trend	Level	Policy
1	Sweden	65.6			
2	Germany	64.5			
3	Iceland	62.6			
4	Mexico	62.5			
5	India	62.4			
6	Hungary	61.0			
7	United Kingdom	59.2			
8	Brazil	59.0			
9	Switzerland	59.0			
10	Argentina	58.5			
30	Netherlands	50.1			
31	New Zealand	50.0			
32	Croatia	49.7			
33	South Africa	49.5			
34	Iran	49.4			
35	Estonia	49.2			
36	Finland	49.1			
37	Austria	48.7			
38	Belarus	47.8			
42	Japan	46.9			
43	Greece	46.8			
44	Ireland	46.4			
45	Cyprus	46.0			
46	Singapore	45.4			
47	Ukraine	44.7			
49	Malaysia	44.2			
50	Russia	43.9			
51	Korea, Rep.	41.3			
52	Luxembourg	39.2			
53	Canada	37.6			
54	Australia	35.5			
55	USA	33.4			
56	Saudi Arabia	30.0			

Emissions Trends (50% weighting)
Climate Policy (20% weighting)
Emissions Levels (30% weighting)

Rank	Tendency	Country	Score**	Partial Score Trend	Level	Policy
4	→	Brazil	70.5			
5	→	Sweden	69.9			
6	↗	Norway	67.0			
7	→	Germany	67.0			
8	↘	United Kingdom	65.9			
9	↘	France	64.6			
10	↘	India	64.1			
11	→	Mexico	64.0			
12	↗	Malta	63.8			
13	→	Switzerland	63.6			
29	→	South Africa	56.6			
30	↘	Netherlands	56.4			
31	↗	Finland	55.1			
32	↗	Singapore	55.0			
33	↓	Denmark	54.6			
34	↗	Korea, Rep.	54.5			
35	↘	Spain	54.4			
36	↗	Ukraine	54.1			
37	↑	New Zealand	53.7			
39	↘	Japan	53.1			
52	↓	Iran	47.2			
53	↘	Malaysia	47.1			
54	↘	USA	46.5			
55	↘	Poland	46.3			
56	↘	China	44.9			
57	↗	Canada	43.9			
58	↘	Australia	42.9			
59	↘	Kazakhstan	42.5			
60	→	Saudi Arabia	25.8			

Index Categories
Emissions Trend (50% weighting)
Emissions Level (30% weighting)
Climate Policy (20% weighting)

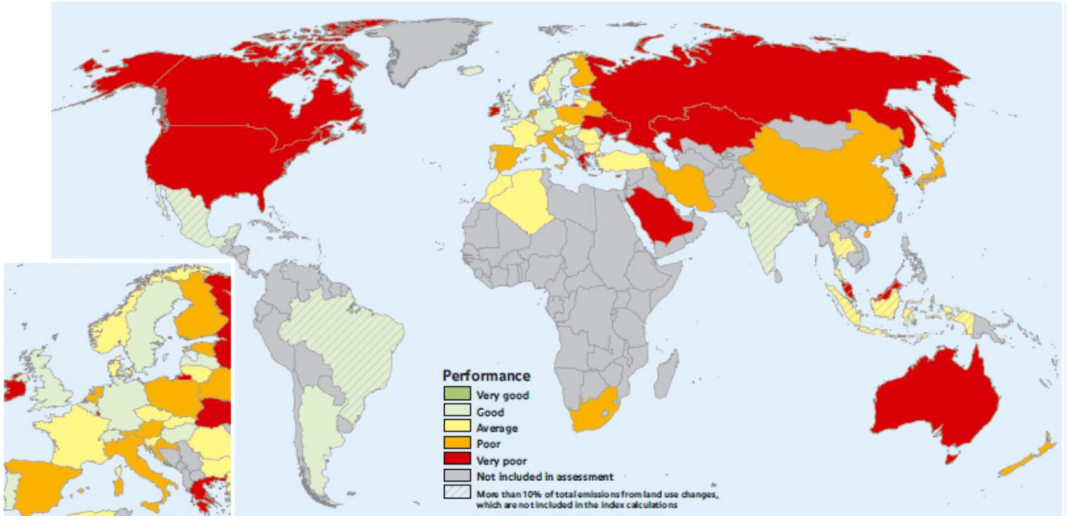
Rank	Tendency	Country	Score**	Partial Score Trend	Level	Policy
4	▲	Denmark	72.61			
5	–	Sweden	69.37			
6	▲	Portugal	67.81			
7	▲	Switzerland	67.61			
8	▼	Germany	67.54			
9	▲	Ireland	67.48			
10	▼	United Kingdom	67.33			
21	▲	Italy	61.26			
22	▲	Slovenia	60.98			
23	–	Cyprus	60.94			
24	▼	India	60.77			
25	▲	Lithuania	60.23			
26	▲	Luxembourg	59.56			
27	▲	Spain	59.18			
28	▲	Czech Republic	59.13			
29	▼	Egypt	59.04			
30	▼	Latvia	58.63			
31	▼	Norway	58.38			
33	▼	Brazil	58.20			
34	▼	Austria	58.09			
35	▼	Belarus	57.98			
36	▼	Indonesia	57.07			
37	–	South Africa	56.70			
38	▼	Finland	56.58			
39	▲	Croatia	56.37			
40	▲	Australia	55.39			
41	–	New Zealand	54.48			
42	▲	Bulgaria	54.27			
43	▲	United States	53.51			
44	▲	Poland	52.47			
47	▼	Japan	52.10			
48	▼	Greece	52.04			
49	▼	Netherlands	50.28			
50	▲	Argentina	49.97			
51	▼	Korea	49.93			
52	▼	Chinese Taipei	49.40			
53	–	Singapore	49.13			
54	▲	China	49.03			
55	▲	Malaysia	47.53			
56	▼	Russian Federation	46.65			
57	▲	Turkey	46.60			
58	▼	Canada	45.16			
59	–	Kazakhstan	39.96			
60	–	Islamic Rep. of Iran	35.81			
61	–	Saudi Arabia	26.90			

Emissions Level (30% weighting)
Emissions Development (30% weighting)
Renewable Energy (10% weighting)
Efficiency (10% weighting)
Policy (20% weighting)

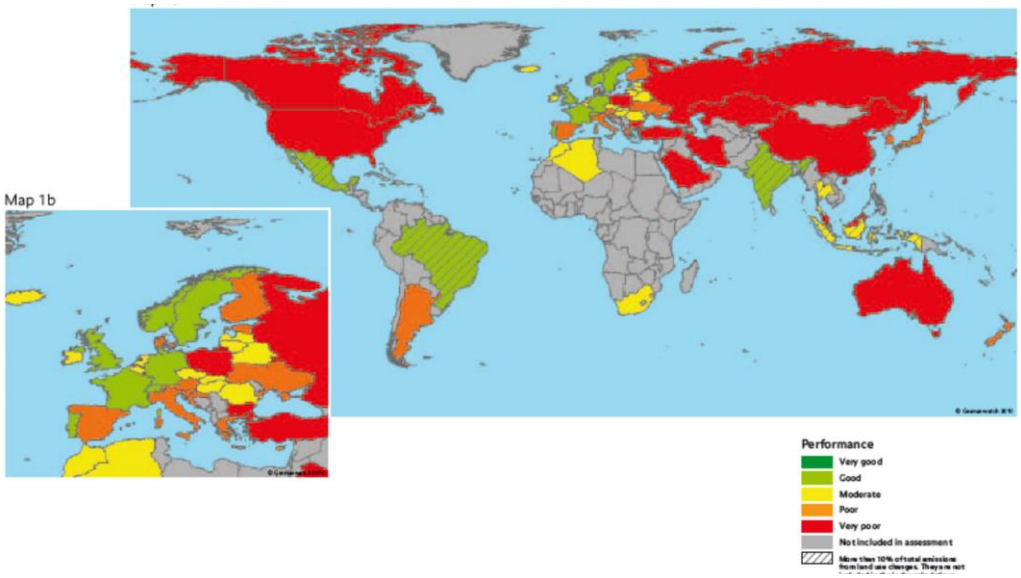
Source: CCPI, results of 2008, 2011 and 2013

Figure 3.65: Climate change performance index, overall results of 2008, 2011 and 2013

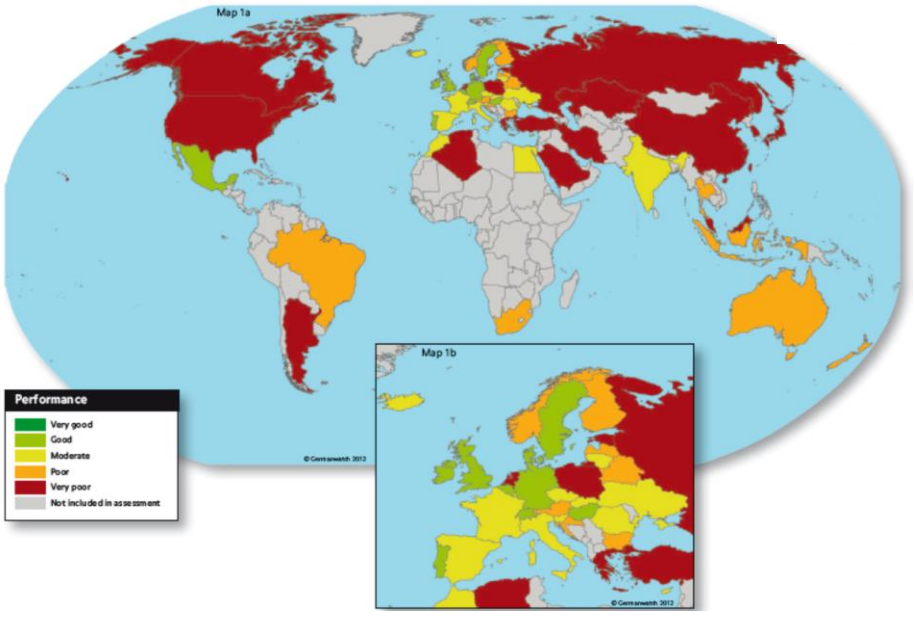
Climate change performance index, overall results of 2008



Climate change performance index, overall results of 2011



Climate change performance index, overall results of 2013



Source: CCPI, results of 2008, 2011 and 2013

As shown in the above figures and statistics, Iran dropped from rank 34 and the middle of the table (2008) to rank 60 and almost the end of the table with “very poor” performance. Therefore, Iran is one of the weakest countries in the field of climate change and policy making for the environment. ” This indicates that Iran will be strongly affected by global warming and climate change during next decades. As the main parts of Iran are hyper arid, arid and semi-arid regions, water shortage is even now a big problem against social and economic development. Mean annual precipitation over the country is about 250 mm where mean annual potential evapotranspiration is over 2100 mm, showing high sensitivity of the state to water related problems. Climate change will definitely intensify this condition over next decades (Dastorani, 2012, p.78).” This emphasizes the malfunction in the Iranian environmental system and the necessity of more research in this field.

3.12.2 Climate change in Tehran

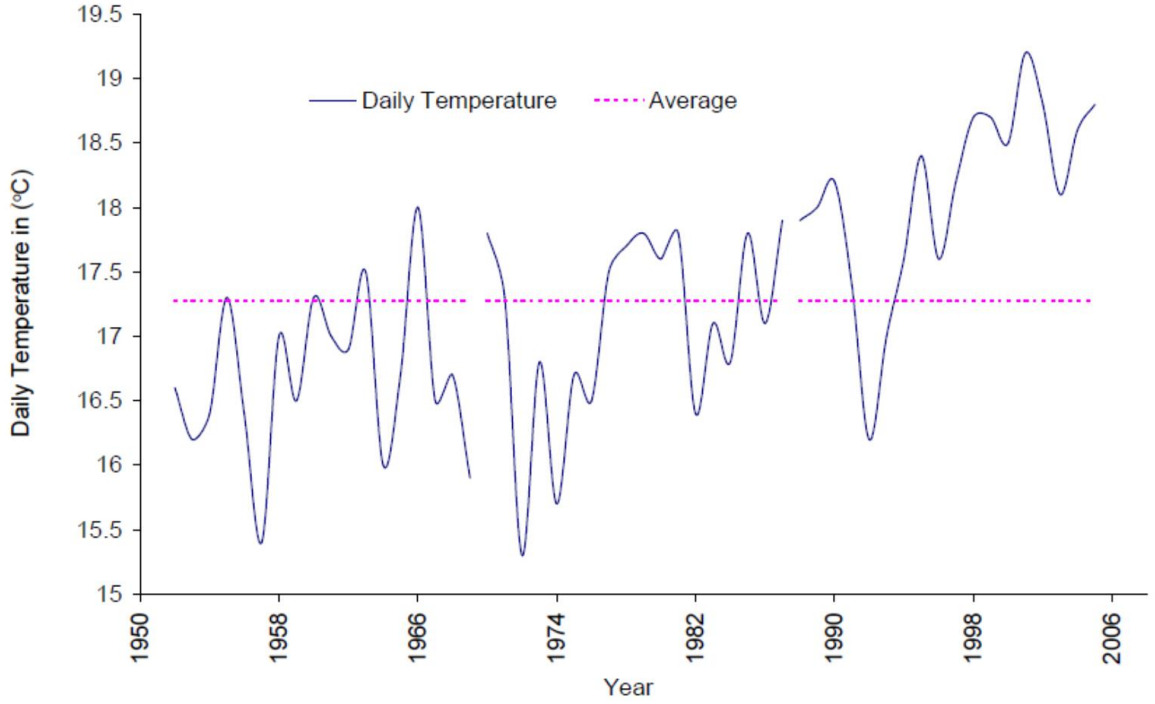
One of the most important phenomena linked to urbanism and urbanization which could alter the relations between humans and the environment and that is endowed with great harmful and destructive effects, is urban sprawl which has great undesirable socioeconomic and environmental effects such as air pollution, destruction of productive farming lands around the cities, destruction of forest cover, absence of landscape protection, reduction of social capital and consequently social relationship. Tehran, the capital of Iran, may be considered as an example of these expanded cities, as it has become the main target of immigration due to its large number of attractive factors. Besides rapid population growth, Tehran also experiences rapid physical growth. This phenomenon presents very undesirable effects on different aspects of the city. One of the most important environmental phenomenon occurring is the change of the local climate (Roshan et al., 2010, p.44).

“Ranjbar Saadatabadi et al. (2005) studied the impacts of urbanization on weather and climate- induced changes in Tehran Metropolitan area. Results of this research indicated a dramatic increase in the minimum temperature compared to its maximum and heat island intensity in Tehran compared to other large cities in the world. Also researches by Rahimi et al. (2011) suggest that developing urbanization caused the relative increases in light rains and decline in the number of days with medium and heavy rains in Tehran metropolitan area. Studies done by Jacqueline et al. (2003) demonstrated the same results in Sydney metropolis (Ragsali, 2010, p. 36).”

“On the other hand, the rapid growth of the city has led to the widespread destruction of urban gardens and farms of the city to be replaced by buildings and roads. None of Tehran metropolitan areas districts contains considerable green space per capita. Central regions of the Tehran metropolitan area contain the lowest urban green space while they are the most populated and polluted regions (Faryadi et al., 2008 quoted after Ragsali, 2010, p.36).” Since 60 percent of the oxygen needed is produced by plants, vegetation is necessary in Tehran to produce oxygen. The per capita green area in Tehran is estimated to be 9 square meters in the year 1997 where as the standard is at least 25 square meters (Abbaspour et al., 2004, p.37). Based on the report by Tehran Parks and Green Space Organization, the Tehran green space per capita amounts to 7.5 square meters (Ragsali, 2010, p.36).

In order to determine changes in the climate variables in relation to long-term averages, trends of these changes were measured by Roshan et al. (2010) in a research about climate changes in Tehran for three 18-year segments and compared to the long-term mean. In figure 3.66, the trend of daily temperature is presented. A value of r =0.7 significance level (correlation) indicates that the increasing temperature of Tehran is fully significant. Also, the highest value is the long-term mean in the third course.

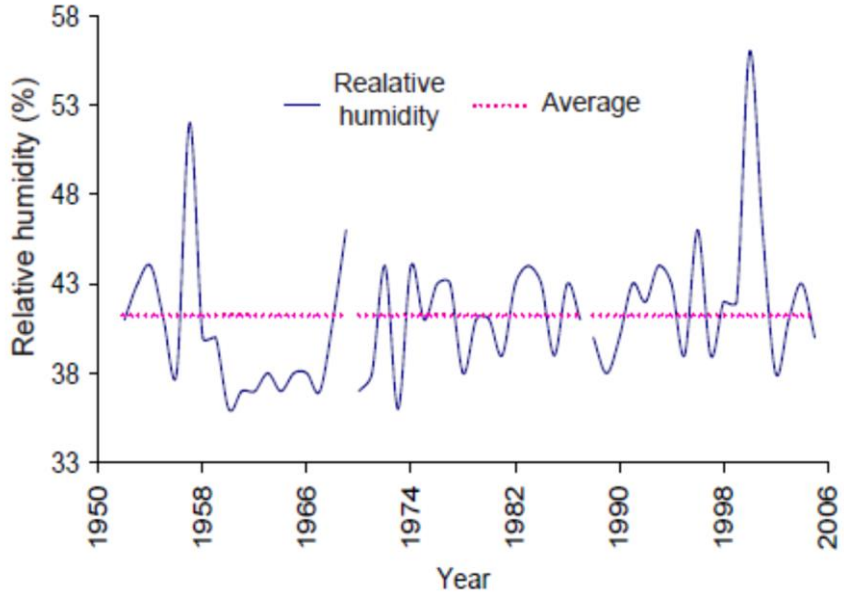
Figure 3.66: Annual mean of daily temperature in Tehran in proportion to long-term mean for the years 1950-2006



Source: Roshan et al., 2010, p. 47

The trend of annual relative humidity is shown in Fig. 3.67. In this case the correlation is r =0.3 for a significance level of 2%. According to the literature on urban heat island, one important effect of urbanization is the decrease of relative humidity of cities. The higher the temperature, the more the capacity of air mass for absorbing humidity. This factor causes the decrease of the ratio of relative humidity to air mass. But in Tehran the remarkable increase of relative humidity seems to contradict this statement. This increasing humidity for the average of the first segment is 40%, for the second segment is 41% and for the third segment is 42.33%. What is interesting about this trend is that it appears to be clearer in summer and for the recent periods.

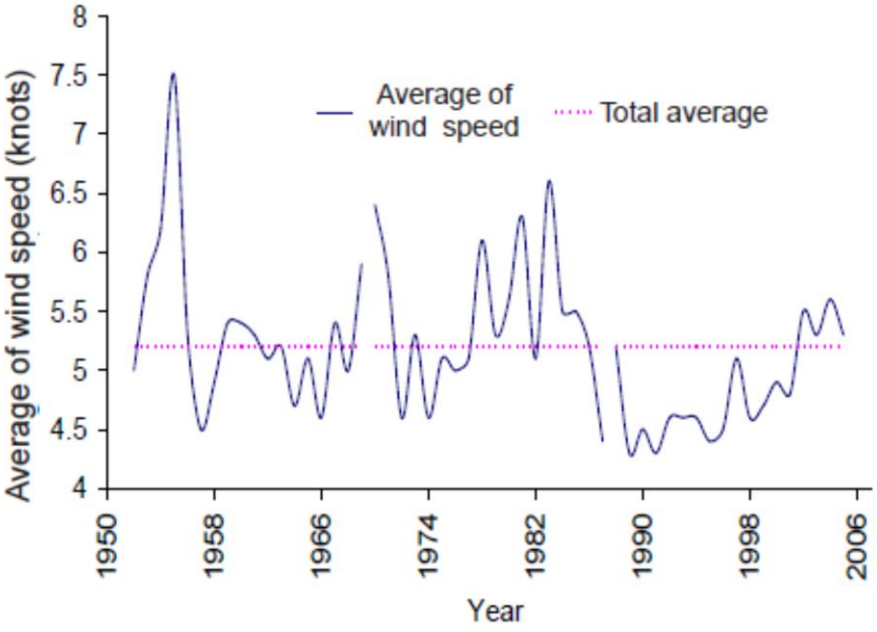
Figure 3.67: Annual mean of the percentage of relative humidity in Tehran in proportion to long-term mean for the years 1950-2006



Source: Roshan et al., 2010, p. 47

Figure 3.68 shows the annual averages of wind speed. A coefficient of r =0.31 has been calculated for this case, with a significant correlation of 2%, meaning that wind speed decreases with passing of time. It may be concluded that the values of wind speed for the third segment (1989-2006) are the lowest in relation to the long-term mean.

Figure 3.68: Annual average wind speed in Tehran in relation to long-term average (1950-2006)



Source: Roshan et al., 2010, p. 47

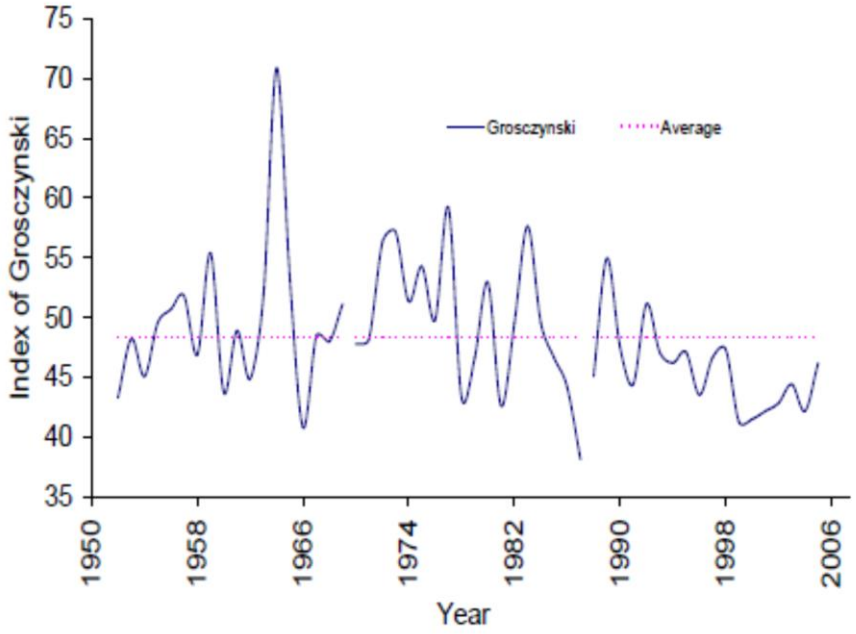
Since the purpose of the above research was to study changes in climatic variables, the type of climate in Tehran during the last decades has been evaluated. For this purpose, the climatic variables of each year were calculated and a trend was obtained, by using the Gorczynski climate determination method. He has presented the scope of each type of climate chnage as presented in table 3.9. Figure 3.69 shows changes in climate variables for a period of 54 years. In general and in accordance with data for this period, C coefficient for the long term period (1953-2006) of Tehran is 48.34%, meaning that Tehran is located in semi-continental climatic area. However, this coefficient is 49.58% for the first (1953-1970), 49.72% for the second (1971-1988) and 45.63% for the third (1989-2006) segment. For all segments the climate of Tehran can be defined as semi-continental, especially the values for the third segment seem to suggest that the climate of Tehran is moving towards more marine and humid conditions (Roshan et al., 2010, p.47).

Table 3.9: Scope of Gorczynski climate categorization

0‹C‹20	High Marine climate
20‹C‹30	Marine climate
30‹C‹40	Semi-Marine climate
40‹C‹50	Semi-Continental climate
50‹C‹60	Continental climate
C‹60	High Continental climate

Source: Roshan et al., 2010, p. 47

Figure 3.69: Annual mean changes of Gorczynski climate index for Tehran in proportion to long-term mean for the years (1950-2006)



Source: Roshan et al., 2010, p. 48

According to the above research, the most effective factor in increasing the temperature of Tehran could be the increase in the number of automobiles. On its part, the most effective factor in the increase of relative humidity of Tehran appears to have been the expansion of city area. Whereas the most important factor which is effective in the increase of calm wind has been population. (Ragsali, 2010, p.36)

-Air pollution standard indexes in Tehran

"Air pollution is the biggest environmental problem that Iran currently faces especially in the capital city of Tehran. About 1.5 million tons of pollutants are produced in Tehran annually, with carbon monoxide from car exhaust making up a large percentage of these pollutants. Tehran's air pollution is made even worse by its geographic position. The city is hemmed in by mountains to the north and east, causing the increasing volume of pollutants to become trapped, hovering over Tehran when the wind is not strong enough to blow the pollution away. Tehran's high altitude, ranging between 3,300 and 5,000 feet, also makes fuel combustion inefficient, adding to the pollution problem. The combination of these natural and artificial factors causes Tehran to be one of the most polluted cities in the world, accompanied by Mexico City, Beijing, Cairo, Sao Paulo, Shanghai, Jakarta, and Bangkok (Halek et al., 2004 and Hosseinpour et al., 2005 quoted after Khalilzadeh et al., 2009, p.36)." "The cost of traffic congestion in the capital is put at two billion hours of time wasted each year. Tehran has also recorded SO2 levels four times the standard prescribed by the World Health Organization (Khalilzadeh et al., 2009, p.35)."

Emission standards for new and imported cars in Iran have first been established by the 1993 Clean Air Act and has been amended in 1999 (DOE [1],1999). These standards have been limited to CO, HC, and NOx emissions from vehicle exhaust gases. The emission standards for petrol fueled vehicles and in-use gasoline fueled vehicles established in 1994 were presented in the form of tables and its executive articles have been prepared by the High Council for the Environment in 1998 (Abbaspour, 2004, p.29).

"The air pollution legislation in Iran included the air pollution prevention Act of 1994, according to the article 4 of 1994. Act, the use of highly smoked vehicles are prohibited and automobile air pollution standards based on

[1] Department of Environmental Standards of Iran

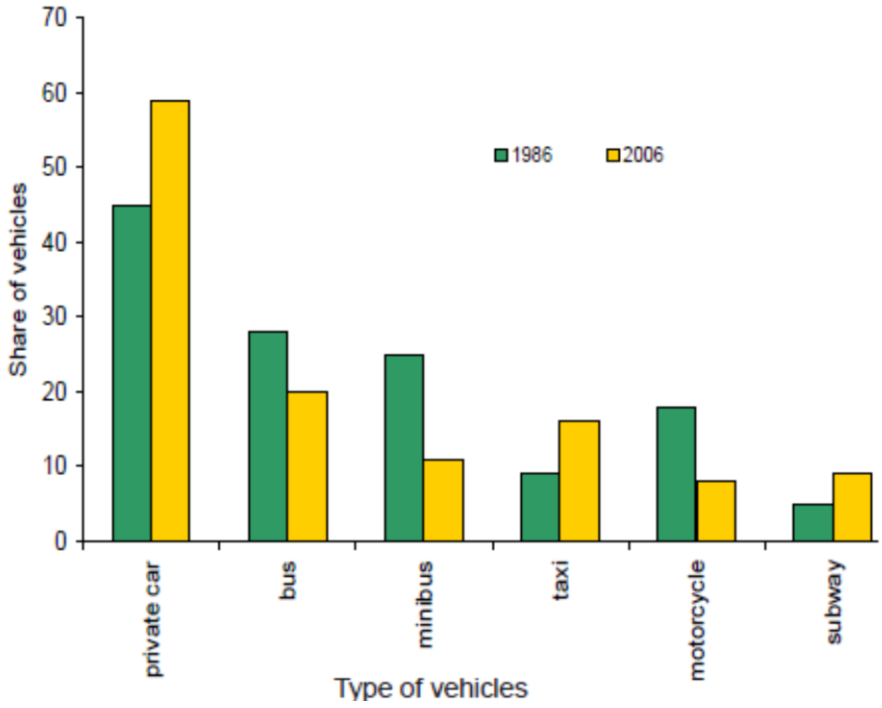
European standard, ECE 1504 or equivalent 83/351/EEC have been created and automobile manufacturers and importers have been asked to specify recommended control strategies. A council of environmental quality has been created giving the power to set national air quality standards and to require highly air polluted provinces such as: Tehran, Isfahan, Tabriz and Mashhad, to develop implementation plans to meet mandatory legislative. The 1999 emission regulation polluted provinces such as: Tehran, Isfahan, Tabriz and Mashhad, to develop implementation plans to meet mandatory legislative. The 1999 emission regulation standard with major impacts on transportation and project development in studied area is not meeting the National Ambient Air Quality standards (Abbaspour et al., 2004, p.27)."

Indeed and because of the increasing of urban sprawl of Tehran, the distance between the place of work and the house of citizens' has increased. According to Transportation and Traffic Studies in the Municipality of Tehran (2003) conducted by the office of deputy of traffic and transportation of Tehran municipality, the mean of distance of urban travels in Tehran was 2.4 km in 1976, in 2000 it reached 8.7 km.

Besides the increasing distances in city commuting, the type of transportation has changed with urban sprawl as well. That is, on the one hand, cycling and walking tend to decrease and in favor of using private cars. The share of private cars in transportation of Tehran was 41% in 1986, in 2006 it had increased to 58% (Figure 3.70).

The subway of Tehran, operating since 1995, covers just a small portion of the city. However, buses have been more successful than the subway, but not enough to give service to the whole city. The results of all these factors (the increase of distance in city commuting and the increase in the use of private cars), is the increase of consuming fossil fuels in transportation. According to Fuels and Oil Products Company of Iran (2007), in 1976 the daily consumption of various fossil fuels (petrol, gasoline and CNG) in Tehran has been 6,000,000 liters; by 1996, it had amounted to 16,500,000 liters, and in 2006 it reached 32,000,000 liters. The increase of consumption of fossil fuels in the transportation section has caused the emission of greenhouse gases in the city air (Roshan et al., 2010, p.49).

Figure 3.70: The share of different transportation systems in Tehran between 1986- 2006



Source: Roshan et al. 2010, p.49

Total annual emissions from mobile sources in Tehran have been calculated according to AQCC [1](1997) data as followed; 9.4 million tons of CO2, 20,500 tons of PM-10, 17,458 tons of SO2, 1,284,443 tons of CO, 104,042 tons of NOx, 115,643 tons of NMVOC (non-methane hydrocarbons) (Soltanieh, *et al.*, 1997 quoted after Abbaspour, 2004, p.29). All the above mentioned values do not meet the WHO and National Air Quality recommendations (Abbaspour, 2004, p.29).

-Air pollution, climate change and human health in Tehran

As explained in chapter 2, "air pollution contributes to preventable illness and death. Subgroups of patients who appear to be more sensitive to the effects of air pollution include children, the elderly, and people with existing chronic cardiac and respiratory diseases such as coronary artery disease, chronic obstructive pulmonary disease" (Khalilzadeh et al., 2009, p.36). It is estimated that about 27 people die each day in Tehran from pollution-related diseases. According to local officials, 3,600 people died in a single month due to the hazardous air quality (Tehran, 2014)."

In 1999 the Department of the Environment of Islamic Republic of Iran announced that the costs of Tehran's Air Quality improvements have been estimated to be $ 1.9 billion (DOE, 1999) in a 10 year plan. The annual indirect costs of air pollution are calculated in figure 3.71 to be $ 424 million, and taking into account the World Bank interest the indirect costs reaches to about $ 6 billion. Available statistics (Behesht, Zahra Org.1998) indicate that, the total deaths in Tehran are estimated to be 41777 in 1998. It is estimated that air pollution contribute to as many as 1 in 17 deaths (Brown, 1991 quoted after Abbaspour, 2004, p.36). Deaths related to air pollution in Tehran is estimated to be 5.7 percent of all deaths in the same year. It is estimated that every dollar spent on air pollution control saves $ 20 in health care cost (Cannon, 1990 quoted after Abbaspour, 2004, p.36). Therefore, to improve the quality of the Tehran air, the sum of $ 1.9 billion is needed and if such an investment takes place, human health benefits will be about $ 38 billion (1.9*20=$38 billions) (Abbaspour, 2004, p.36).

Figure 3.71: Direct and indirect costs of air pollution in Tehran

Cost of Tehran's air pollution reduction (Direct cost)	$1.9 millions
Cost of gasoline over use and petrol evaporation (indirect)	$317 millions
Cost of life saving (indirect)	$53 millions
Cost of extra hygiene (indirect)	$17 millions
Cost of car wash (indirect)	$33 millions
Cost of human Illness (indirect)	$4 millions

Source: Abbaspour, 2004, p. 36

The effect of air pollution indexes on human health has been studied by Khalilzadeh et al. in 2009 about Tehran. During the 12-month period from April 2004 to March 2005, the concentrations of 5 air pollutants including CO, NO2, O3, SO2, and PM10 were measured at four stations located in the North, the West, the South, and the central part of Tehran. The levels of air pollutants were compared by calculating the values of the *Pollution Standard Index* (*PSI*). The monitoring (sampling and analysis) was carrying out continuously, but the data for each day covered a 24-hour period, beginning and ending at 10 a.m. each day. In a cross-sectional method, the number of cardiopulmonary admissions in emergency wards of different hospitals in Tehran and level of air pollutants of CO, NO2 O3, SO2, and PM10, were measured, and their correlations were assessed.

"The total results were as follows:

[1] Air Quality Control Company

- CO: 54.9 % standard condition, 35.2% unhealthy, 9.8% very unhealthy and 0.3% hazardous condition.
- O3: 100% standard condition for all stations.
- SO2: 98.6% standard condition and 1% unhealthy condition.
- NO2: 100% was standard condition for all stations.

The results demonstrated that the number of admissions because of cardiopulmonary complaint was positively correlated with concentration of all studied pollutants except ozone (O3), and its correlation was statistically significant with carbon monoxide (CO) and PM10 (*r = 0.73, p = 0.016, r = 0.75, p = 0.012*, respectively). The correlations between levels of the five criteria variables measured and hospital admissions for cardiorespiratory conditions are presented in table 3.10 (Khalilzadeh et al., 2009, p.37)."

Table 3.10: Correlation between pollutants and hospital admissions in Tehran (2004-2005)

		NO. of admissions	CO	O_3	NO_2	SO_2	PM-10
NO. of admission	Pearson Correlation	1.000	0.731*	-0.340	0.574	0.424	0.752*
	Sig. (2-tailed)	.	0.016	0.336	0.083	0.222	0.012
	N	10	10	10	10	10	10
CO	Pearson Correlation	0.731*	1.000	0.081	0.797**	0.194	0.947*
	Sig. (2-tailed)	0.016	.	0.825	0.006	0.562	0.000
	N	10	10	10	10	10	10
O3	Pearson Correlation	-0.340	0.081	1.000	0.068	-0.458	-0.002
	Sig. (2-tailed)	0.336	0.825	.	0.852	0.183	0.996
	N	10	10	10	10	10	10
NO2	Pearson Correlation	0.574	0.797**	0.068	1.000	-0.117	0.711*
	Sig. (2-tailed)	0.083	0.006	0.852	.	0.748	0.021
	N	10	10	10	10	10	10
SO2	Pearson Correlation	0.424	-0.194	-0.458	-0.117	1.000	-0.124
	Sig. (2-tailed)	0.222	0.592	0.183	0.748	.	0.733
	N	10	10	10	10	10	10
PM-10	Pearson Correlation	0.752*	0.947**	-0.002	0.711*	-0.124	1.000
	Sig. (2-tailed)	0.012	0.000	0.996	0.021	0.733	.
	N	10	10	10	10	10	10

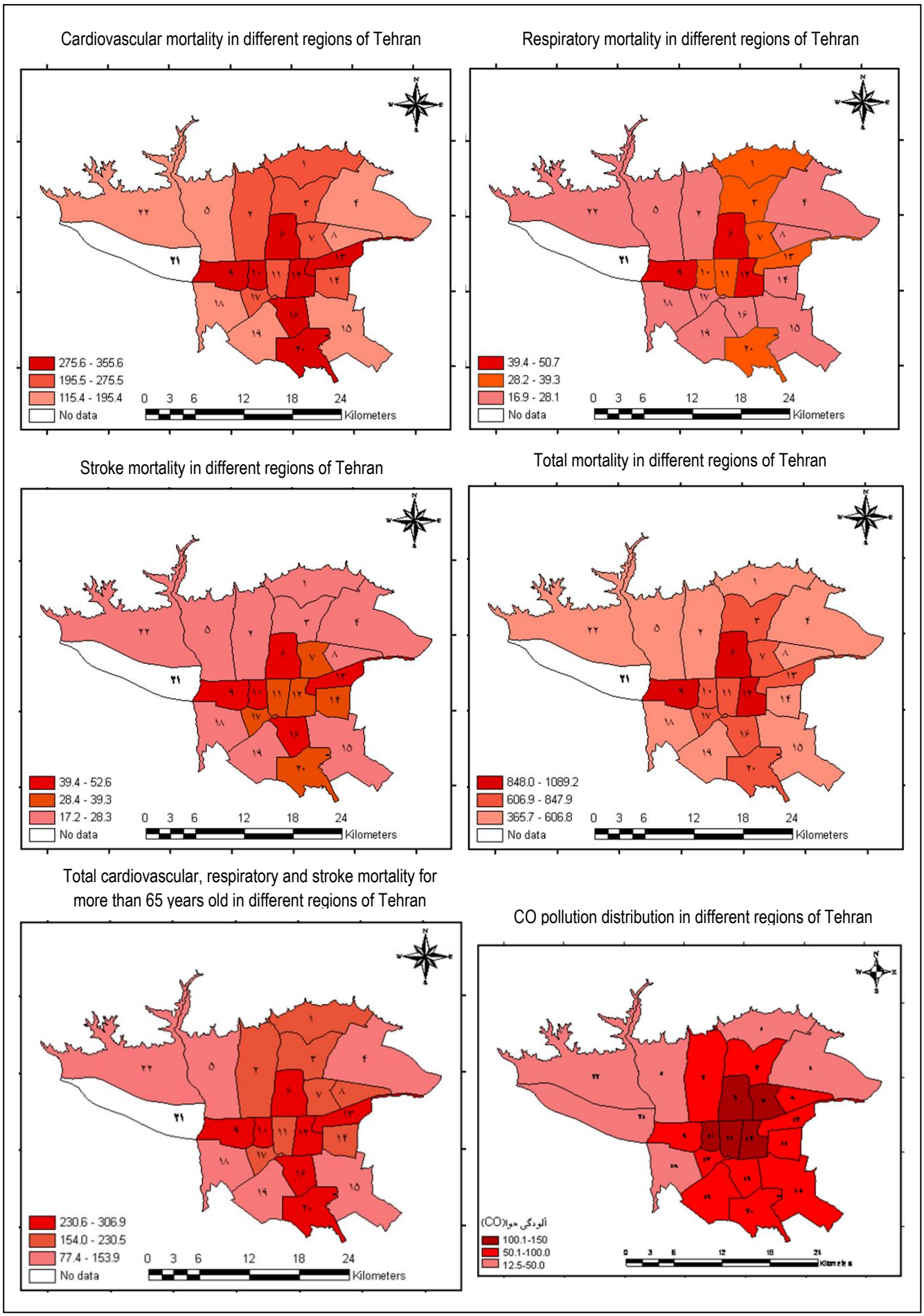
*. Correlation is significant at the 0.05 level (2- tailed).

**. Correlation is significant at the 0.01 level (2- tailed).

Source: Kahlilzadeh et al., 2009, p.38

In 2008 Darand and Farajzedeh conducted some of research and Farajzadeh wrote his master dissertation about the influence of climatic parameters on mortality in Tehran. The GIS maps as shown in figure 3.72 are presented for the analysis and the final discussion. The illustrations of the figure 3.69 are summarized in table 3.11. The results of this study shows that the most co-polluted regions (zones) of Tehran in 2002- 2005 were 6, 12, 11, 10, 7 which shows that the center regions are more polluted than the northern and western ones. The highest numbers of cardiovascular mortality exhibit in regions 6, 9, 10 and 12 and the lowest numbers in regions 5, 4, 18, and 22; therefore, it can be claimed that central regions have more cardiovascular mortality than northern and western ones as well. Moreover the highest numbers of respiratory mortality are concentrated in regions 6, 9 and 12 and the lowest in regions 5, 4, 18 and 22. This also indicates that central regions have more respiratory mortality than others. This trend is repeated regarding stroke mortality and the people over 65 years. To sum up, the overall mortality is located mostly in regions 6, 9 and 12 and this proves that the regions with higher concentrations of CO and consequently more air pollution in the center of Tehran show a higher mortality (Darand, 2008, p. 65, 66). Farajzadeh and Darand did the same research for the effects of temperature and precipitation on human health (Farajzadeh and Darand, 2008). More detailed data about the air pollution indexes in Tehran will be focused and analyzed in case study specification in chapter 5. These data will be used in two-step process to choose the regions that are given in this study.

Figure 3.72: Correlation between mortality and air pollution in different regions of Tehran (2002-2005)



Source: Darand, 2008, p.67-69

Table 3.11: Correlation between pollutants and hospital admissions in Tehran (2004-2005)

Total mortality	mortality of more than 65 years age	stroke	respiratory	cardiovascolar	Air pullotion rate	zones
599/7	201/8	25/8	29/2	223	38/1	1
481/1	174/8	24/6	23	196	51/8	2
449/5	211/3	28/3	30/3	236/9	85/6	3
365/7	121/7	17/2	17/8	147/6	42/9	4
384/7	130/5	19/9	18/3	156/2	24/6	5
921/5	303/4	42/7	41/4	333/4	122/3	6
623/3	219/4	31/9	29/8	246/8	124/8	7
470	166/2	24/5	21/4	192/2	78/7	8
956/9	306/9	52/6	43/3	355/6	61/4	9
705/5	246/3	39/8	32/6	301/8	108/3	10
627	203/6	30/5	28/3	233/8	123/3	11
1089/2	253/3	33/8	50/7	315/6	129/1	12
716	253/7	40/8	29/8	290/9	95	13
535/4	191/2	29/9	23/6	224/6	83/6	14
445/9	141	22/6	19/3	181/5	51/5	15
709/5	258/3	40/9	27/5	296/8	93/3	16
610/9	192/7	34/8	24	231/8	75/1	17
414	112/2	19	16/9	145	39/9	18
514/4	138/1	22/5	21/7	179/8	72/3	19
767/8	246/6	38/2	34/8	300/4	55/6	20
No data	No data	No data	No data	No data	15/6	21
527/4	77/4	14/2	18/4	115/4	12/5	22

Source: Darand, 2008, p.63

3.13 Quality of life

The term ‘quality of life’ has been the subject of many studies and is a compound variable determined by the interaction of various indicators. Measuring the quality of life in urban areas has become a necessary key research tool to promote urban planning and management in modern cities. Studies show that the quality of life depends on two types of factors: 1) objective factors 2) subjective factors. Objective factors or criteria show life standards in general while subjective factors show the attitude of people towards their lives as they compare themselves with the implied standards. There has been a lot of debate on whether, in studying the quality of life, it is necessary to consider both types of factors, or to what degree each type of factors contributes to the quality of life. The present study applies objective factors to measure the quality of life in different districts of Tehran. In doing so, first, the indicators showing quality of life have been extracted from the related literature and experiences. Then, they have been adopted in the context of Tehran, and the availability of information required in the various districts of the city has been examined. The indicators showing quality of life have then been selected. To examine the various dimensions of the quality of life, first the indicators of urban services and facilities in the districts of Tehran have been divided into five groups, using a clustering analysis method: “quite good” , “good” , “to some extent good” , “not good”, “very bad”.

To examine different aspects of the quality of life, a factorial analysis method was used. Using this method, 27 indicators showing different aspects of the quality of life (see Figure 3.73) have been divided into 4 groups, each indicating one aspect of the quality of life: the access to urban facilities and services; the quality of social territory; the quality of housing and the quality of the environment. By overlaying all the indexes mentioned the final map

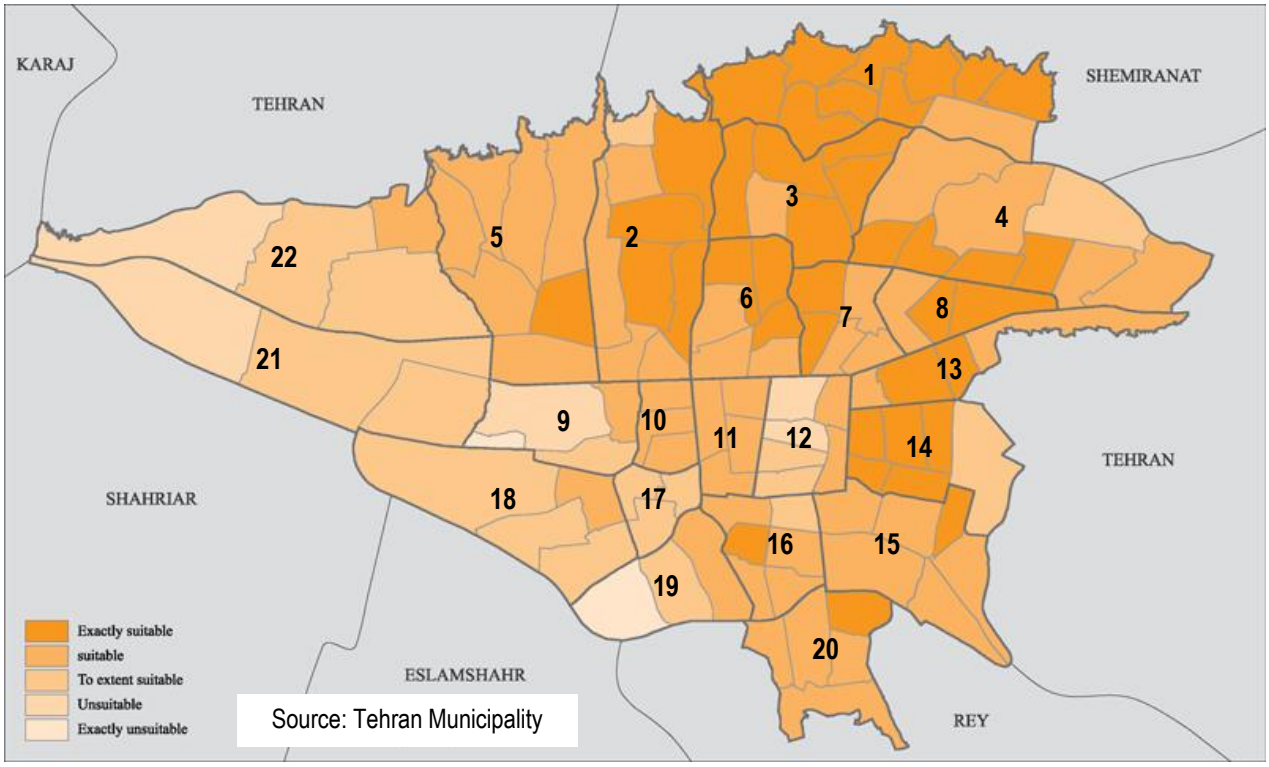
(Figure 3.74) has been produced for all the regions of Tehran. To obtain a picture of the general quality of life in Tehran, the four dimensions of the quality of life mentioned above are measured. Northern, central north and northeastern districts have the best conditions. The quality of life in the northwestern and southeastern districts is also good. In the southwestern districts, quality of life is rather good. In two districts in region 9, the poor quality of life is basically due to high environmental pollution. In one district in region 19, the poor quality of life is due to its poor social environment and its relatively high environmental pollution. In one district in region 18, poor quality of life is basically due to its poor social environment, high environmental pollution and poor access to urban services and facilities. In two districts located in the west end of the city, and in the regions 21 and 22, the poor quality of life is mainly due to the poor access to urban services and facilities; and in two districts in region 12, poor quality of life is mainly due to their poor social environment and poor housing quality. The Term “percent of household” describes normal households which are not mobile and have a specific address and solid building. These households do not live in tents and shelters; they are immobile normal households and do not move to different regions of Iran according to the weather and seasonal changes, as mobile normal households do. In addition these households are defined as persons who spend money together, i.e. they live as an economic and social entity.

Figure 3.73: Indicators of quality of life

No.	Index	No.	Index
1	Literacy ratio	15	Access to high school
2	Employment ratio	16	Access to health center
3	Person per residential unit	17	Access to hospital
4	Property ownership	18	Access to Ambulance
5	Residential units with bathroom&kitchen	19	Access to fire station
6	Residential units with water,electricity	20	Access to police station
7	Residential units with 3rooms and more	21	Access to parks
8	Percent of unskilled Labour	22	Access to sport complex
9	Air polution	23	Access to metro station
10	Noise polution	24	Literacy ratio of men (over 6 years old)
11	Access to acceptional children school	25	Literacy ratio of women (over 6 years old)
12	Access to Nurseryschool	26	Percent of household
13	Access to primary school	27	Percent of residential units with 101-200 m^2
14	Access to junior high schoool		

Source: Tehran Municipality

Figure 3.74: Quality of life in the regions of Tehran



3.14 Tehran in one view

Tehran has residents with remarkable different social levels that should be taken into consideration in any study. Geographical locations reflect the social level, as in most of the neighborhoods there is a strong correlation between a high topography and a high social level. Most traditional families live south of the center and the wealthy residents are more concentrated in northern regions such as 1, 2 and 3. There is a fine point which cannot be presented by maps but is within the layers of the society; people lacking a good financial situation are usually the traditional ones but traditional people can both be wealthy or not. In addition, there are two types of traditional people; the ones whose values are based on old Persian culture and the ones who are religious but that are often considered as new-rich by the first type. It is absolutely hard to map these social classes. The population density of the households which is an indicator of cultural, economic and social identity is low in the northern and western parts of Tehran; as far as the western region 22, this can be misleading as this region is relatively new and not fully developed yet.

The status and marriage of women are indicators for tradition which can help categorizing the social levels in Iranian society. So as pursuing a higher education in the higher classes of the society has been a reason to postpone the marriage, there have been less marriages in the regions 1, 2 and 3 than in southern regions such as 18, 19 and 20. On the other hand, in these regions there have been less divorced people reported due to the traditional culture and its values. Nevertheless, the percentage of employed women which reflects the cultural status and the right of a woman to live outside is high in regions 2 and 3. This rate is low in region 1 although this region has high cultural status. This contradiction stems from the fact that women have no financial need here to work but they have their outside lives by attending arts, sports and cultural classes.

Moreover, another indicator which represents the socio-cultural levels and the development in the society is the literacy ratio which decreases from the northern parts of Tehran to the southern ones. This gap is so wide that there could be households found in the south without one literate member whereas in the northern regions 1, 2, 3 and 6 nearly exclusively lives the population with higher education. Regions 18, 19 and 20 in south range the

lowest. Occupation after study classifies the financial layers of the society. In region 1, 2, 3, 5 and 6 there are more experts and legislators whereas social work related jobs and vehicle drivers are more concentrated in southern regions.

The dependency ratio shows that southern regions have a lower degree of welfare. Once again region 1 has a misleading indicator; as it is expected, the dependency ratio is not in the lowest range, thus showing the highest welfare. The reason is that due to the good financial situation not all the residents of this region need to work so the number of the employed residents decreases and cause a higher dependency ratio. Furthermore, bigger residential units are located in the northern regions which again submit the socio-economic level of this area.

Last but not the least, the most valuable rural textures which have remained from the past are in regions 1, 2, 3, 5, 10 and 21 which have gardens as their valuable textures as well. Besides, regions with gardens or agricultural lands such as regions 2, 5 and 18 have been affected by the most building permits issued during the last almost 20 years. Region 1 with the high amount of gardens has the most 10-floor building permissions in 2000 and 2001 which reflects the high rise development in this area because in these years the new concept of High rise- garden emerged in Tehran urbanism.

All in all, the information and maps in this part are to illustrate the socio-economic situation of Tehran and to emphasize the importance of taking this information into consideration in any urban plan. The big gap between Tehran residents' social levels and the existence of different people with the different economic, cultural and social level make it necessary for any researcher or planner to know whom he is planning for. Different policies should be adjusted to different people and the success of a plan might depend on deep social studies. This part tried to highlight the importance of the different social levels in Tehran and shows that from the south to the north people have a higher education, a higher income and occupation, a better socio-cultural level, a better quality of life and more social capital. Therefore, the priorities vary from one region to another which is a very important point to make for defining the preservation plans. People participation as an important element in new successful preservation projects cannot achieve its goals without sufficient information about different levels of the society. Thus, in this multidimensional research socioeconomic data will be entered to have more realistic, practical and feasible results.

4 Iran Preservation and World Wide Best Practices

"Case study is best defined as an intensive study of a single unit with an aim to generalize across a larger set of units. Case studies rely on the same sort of conversational evidence utilized in non-case study research. Thus, a case study should lead the author to answer specific research questions and which seeks a range of different kinds of evidence, evidence which is there in the case setting, and which to be abstracted and collated to get the best possible answers to research questions. This use of multiple sources of evidence, each with its strengths and weaknesses, is a key characteristic of case study research (Gillham, 2000, p.2)."

Therefore in this chapter it is attempted to find the similarities between Tehran and other successful preservation plans/programs around the world. As described in other chapters Tehran has specific characteristics like population, size and socioeconomic situation which makes it hard to find a case study which is similar to it. But as the goal of the research is to ascertain the methods and programs which help the countries to preserve their green fields in the most effective way, these methods, policies and main approaches would be derived from the case studies and the next step would be to localize/personalize the outcomes of universal case studies in the Tehran situation, regardless how different its characteristics may actually be. The structure of a successful preservation system is the main objective of this chapter.

Combining urban development and agriculture is the best compromise in the current situation of agriculture and fast urbanism. Yet to combine this two the first steps should be taken from the city residents. This can be a general thought of the citizens that more urbanized our environment, the less farmland could be found around us but this imagination brings problems to the function of the city as we still need food which can only be produced in farmlands. Unfortunately developing countries with growing population lose more farmlands and experience this fact more than others although their need for food production is higher. This is because they require more flat, affordable and spacious urban areas to build up apartments and urban services near to the residential regions.

This fact stands in front of another value in new urban lives and that is the value of a productive, local, fresh, bio and green farmland with a good accessibility. In other words, the value of being close to "Green" in general with its different faces in the cities. The new cities are the scene of the controversial fight between these two poles which each tries to pull the whole city to itself.

In the middle of this urban challenge, there is a new approach of defining urban attractions for the farmlands; therefore farmlands have to be well located within the cities and at the same time being prevented from demolition. This approach attempts to create multifunctional farmlands within the cities by adding extra functions/land uses. Building agricultural museums for children and adults with different scales of machines, renting small parts of the farmland to families to let them grow their own products as a hobby of weekends and in holidays and creating attractive tourist areas which have been used by 'Agro tourism' in recent years are some examples of the solution. As Sarah Taylor (2010) notices" The challenge (and opportunity) is to design urban agriculture spaces to be multifunctional, matching the specific needs and preferences of local residents, while also protecting the environment." She also emphasizes that the new city planners should consider cities as a place to support "community farms, allotment gardens, rooftop gardening, edible landscaping, urban forests, and other productive features of the urban environment."

Next to the environmental aspects by producing food and fiber, agricultural land generates a series of financial benefits. First, "unlike residential land, farmland tends to supply more revenue in local taxes than it demands in local services (Daniels and Bowers, 1997quoted after Cavendish-Palmer, 2008, p.6)."

Second, "agricultural land keeps the price of certain foods low and maintains a diverse food supply. When food is both imported and grown locally, consumers have access to a wide variety of foods without having pay an excessive amount for items that are easy to grow locally but expensive to transport, such as dairy products (Baxter, 1999 quoted after Cavendish-Palmer, 2008, p.6)."

Third, "farmland and agricultural production provide tax base and investment in rural areas and promote a diverse economy by creating employment in trucking, shipping, food processing, marketing, and many other sectors.

Fourth, preserving local farmland and food production has the potential to boost farming revenues, as farmers often increase their profit margin when they sell products directly to consumers.

Finally, protecting farmland often preserves the character and community heritage of rural areas, which can generate tourism (AFT, 2003; Beesley, 1999 quoted after Cavendish-Palmer, 2008, p.6)."

In the following different preservation programs/plans will be discussed. The urban issue, the main problem of the city in the very beginning, the process, the solutions, the implemented methods and at the end the policies that are recommended will be clarified. The aim is to find out why some countries could be successful and others failed in preserving the green fields in the cities. At the end the main elements of preservation programs will be extracted and organized in a table to make a comparison study between the current preservation rules, regulations and management structure of the successful examples in the world and Iran.

4.1 British Columbia farmlands

According to ALC official website, farmland preservation in British Columbia cannot be represented as a very successful example if the statistics and exclusion/inclusion tables are considered but the total applications which have been submitted to include farmlands in the preserved zones show a successful process. From 2004 to 2009, 633 applications have been submitted whereas 546 applications were submitted in the year 2010 alone. On the other hand, the policies and the progress they have applied during the years, the management structure and the regulation framework being enacted can be useful for setting the policies in Iran.

"Up to the 1970's nearly 6000 hectares of prime agricultural land were lost each year to urban and other uses. The Provincial government responded to the serious erosion of the agricultural land base by introducing BC's Land Commission Act on April 18, 1973.

The primary objective of the original Land Commission Act was to preserve agricultural land and encourage the establishment and maintenance of farms. Secondary objectives were to create parks, acquire greenbelts and assemble land for urban and industrial uses. In 1977 these secondary responsibilities were dropped because they duplicated the efforts of other public agencies (ALC official website, 2014)."

There were three main problems in BC which were interrelated to each other "and led to preservation plans. The main problem started from 1940 to 1950 when the population increased from 805000 to 1.1 million people. This happened when the province Town Planning Act was not prepared and therefore the provision of services was difficult for municipalities. This process end up to increase the amount of urban lands situated on high quality agricultural lands. Next to this situation the political situation played a crucial role. Land-use trends changed in the 1960s with the birth of the environmental movement and concerns about farmland loss in areas around Vancouver mounted. After winning the provincial election in 1972, the New Democratic Party began passing legislation to prevent development on agricultural land, which culminated in the Land Commission Act of 1973. This Act established the ALR and the Provincial Land Commission, which later became the Agricultural Land

Commission (ALC). The first task of the ALC was to determine the boundaries of the Reserve. This was done by examining Canada Land Inventory data on the climate and soil quality of land across the Province, consulting municipalities, and holding a series of public hearings. As explained ALC foundation was a solution in the political and social problems of that time which was highly supported by people.

4.1.1 Preservation body managements in British Columbia

In this part it will attempted to extract the body managements responsible directly or indirectly for farmland preservation in BC based on the documents. "Land-use trends changed in the 1960s with the birth of the environmental movement and concerns about farmland loss in areas around Vancouver mounted. After winning the provincial election in 1972, the New Democratic Party began passing legislation to prevent development on

agricultural land, which culminated in the Land Commission Act of 1973. This Act established the ALR[1] and the Provincial Land Commission, which later became the Agricultural Land Commission (ALC, 2007 quoted after Cavendish-Palmer, 2008, p.9).

The Provincial Agricultural Land Commission (ALC) is an independent Provincial agency responsible for administering the Province's land use zone in favor of agriculture (ALC official website 2014). "The ALC consists of six regional panels, containing three members each, that are politically appointed and rule on all applications to include land into the Reserve, exclude land from the Reserve, and subdivide or pursue non-farm uses on Reserve land (Smart Growth BC, 2007quoted after Cavendish-Palmer, 2008, p.11)." The ALC also has a staff of 23employees that provide Commissioners with information about current policies and by laws pertaining to agricultural land (Campbell, 2006 quoted after Cavendish-Palmer, 2008, p.12).

"The purpose of the Commission is to preserve agricultural land, encourage farming in collaboration with other communities of interest; and also encourage local governments, First Nations, the government and its agents to enable and accommodate farm use of agricultural land and uses compatible with agriculture in their plans, bylaws and policies.

Vision

A Provincial agricultural land reserve system that fosters economic, environmental and social sustainability.

The Commission expects to achieve its mission through the realization of its four complementary goals:

1. Preservation of agricultural land.
2. The encouragement and enabling of farm businesses.
3. A provincial land reserve system that considers community interests.
4. Sound governance and organizational excellence (ALC official website 2014)."

"As every responsibility of management bodies are clarified in law or regulation, Local Governments prepare plans under authority of Part 26 of the *Local government Act* and at the same time they should adhere to all legislation of provincial government including *Agricultural Land Commission Act*. They should also make sure that all plans and bylaws related to lands in the ALR are consistent with the Act and regulations of ALR (Agricultural Land Commission, 2007)."

"Local governments play an important role in land management affecting the ALR. They are the first to see all applications to exclude land from the Reserve, subdivide agricultural lands, and pursue non-farm uses (Smith and Haid, 2004)." They are also in charge of making sure that all bylaws and plans that could have an impact on land within the ALR meet there requirements of the Agricultural Land Commission Act (ALC, 2007).

"During first few years of ALC, the Commission also took on an agricultural research role. Prior to the establishment of the ALR, many agricultural landowners were counting on selling their land to real estate developers to fund their retirement. The creation of the Reserve limited their ability to sell their land for non-farm uses and therefore, usually entailed a decrease in the value of their land. To help farmers cope with this likelihood and provide income protection, the Provincial Government introduced the Farm Income Assurance Act alongside the Land Commission Act (ALC, 2007 quoted after Cavendish-Palmer, 2008, p.9)."

"Agricultural Land commission, appointed by the Provincial government, established a special land use zone to protect BC's dwindling supply of agricultural land. This zone was called the "Agricultural Land Reserve" or ALR. ALR boundaries were based on the capability and suitability of the land, its present use, local zoning and input from public hearings.

Another organization that cooperates with ALC is Ministry of Agriculture, Food and Fisheries. Ministry staff reviews zoning bylaws which regulates farm use in farm areas, including the ALR. Ministry staff work with Commission staff in agri-teams to provide advice to local government planners to help achieve consistency

[1]*Agricultural Land Reserve* which will be explained in further parts.

between bylaws and the ALCA and to meet the requirements of the Local Government Act. The ministry has an objective to maintain a positive regulatory climate within local government jurisdictions to encourage investment in agriculture (ALC, 2007)."

At the Ministry of Agriculture and Lands, the Strengthening Farming Program is the section most closely involved with ALR management (Smith and Haid, 2004 quoted after Cavendish-Palmer, 2008, p.12)." It supports agricultural 28 advisory committees, farmers and agrologists.

Three main governmental bodies have land management roles that affect the ALR: The ALC, the Ministry of Agriculture and Lands (MAL), and local governments. Although these entities often work together, they perform distinct land management duties. The Agricultural Land Commission Act specifies that the purpose of the ALC is to preserve farmland, promote farming, and encourage other governmental bodies to accommodate farming and farmland in their official plans and policies (ALC, 2007)."

"Municipalities can encourage agriculture within their boundaries by appointing agricultural advisory committees, creating agricultural area plans, and enforcing zoning and subdivision bylaws that support farming activities (Curran, 2005 quoted after Cavendish-Palmer, 2008, p.10)." Municipalities and local governments are the first to see exclusions and solve issues concerning plans.

As a result three separate management bodies can be considered with different individual tasks but simultaneously interrelated to each other: Municipalities with technical knowledge beside ALC with implementation power and with the support of MAL as an advisory element. This structure makes the preservation successful with all necessary elements which are working as a system.

4.1.2 Acts, regulations and bylaws

There are different kinds of laws and regulations supporting the preservation structure. They may define preservation area characteristics or clarify the responsibilities of a management body described above. The main goal they all follow is preservation. The implementation power of each act is also another crucial factor which should be taken in to consideration.[1]

The Agricultural Land Commission Act (ALCA) clarifies all the small details concerning ALC in BC. Definition of farmland, Commission goals and policies, relations to other acts, commission members, process and rules of application, subdivisions, exclusion and inclusion are some key parts of the Act. Thus this is more a descriptive law which tries to explain all the preservation's legal procedure.

The ALC Service Plan has a specific strategy to establish Commission guidelines for the preparation of Official Community Plans (OCP's) by local governments. This strategy is designed to meet the specific goal and objective of the Commission. The goal is to encourage and enable farm business and the objective is to meet plans, policies and activities of local governments, agencies and First Nations encourage, enable and accommodate farming (ALC, 2007)." Whereas The Local Government Act may include policies that respect the maintenance and enhancement of farming on land in a farming area or in an area designated for agricultural use in the community plan in official community plans.

The Farm Practices Protection (Right to Farm) protects the farmers' right to farm and provides guidelines for local government zoning in farm areas.

At a higher level the Environmental Management Act (EMA) is the principal environmental statute in British Columbia. It prohibits the introduction of waste into the environment in such a manner or quantity as to cause pollution, except in accordance with a permit, a regulation or a code of practice established by the government for particular activities. It has different provisions but the one relating agricultural lands could be Provide for environmental protection orders and Provide for enforcement procedures and penalties (Blake Lawyers, 2012, p.20)."

[1] The Acts and laws which do not have source in this part have been all extracted from ALC official website 2014.

As a result British Columbia is not an example of a preservation system with plenty of different laws and regulations but there are enough rules set by the government to preserve the existing green lands. There is a main Act, ALCA which is the core of the legal structure of preservation and in this comprehensive act all possible questions directly/indirectly concerning preservation have been responded. Beside at different management levels, local government and provincial rules complete the main Act. As ALC is the main management body in preservation, the crucial rules are in its territory. The case of BC shows that there can be a comprehensive law designated to preservation which covers all the possible gaps and malfunctions. Yet in any urban management level there should be a brief regulation consistent with the main law. This can be a version of a legal framework of a successful preservation structure.

4.1.3 Consistency between ALR and local plans

As ALR is a part of a city structure it should be compatible with the urban plans produced by the authorities, so that the whole urban plan structure has the same approach and direction. "To achieve consistency with the Act, regulations and orders of the commission the following criteria should be met by local government land use plans:

First of all plans involving lands in the ALR should have objectives and policies for agriculture that are supportive of farming and farm compatible activities in the ALR. In addition plans should include a map showing the location of ALR boundaries. Whereas the third criterion is that Lands within the ALR should be wholly contained within a plan designation or zone that permits a broad range of agricultural uses (ALC, 2007)."

Besides these criteria urban elements are considered in ALR. Although ALR is an agricultural zone, the urban elements should try to emerge consistent to green character of the zone. This becomes more crucial when these farms are considered as human settlements. It is a big mission of planners and politicians to make these settlements so livable for today's citizens that they do not leave and purchase the farms to live in developed urban areas. This is the creativity and the art of planners to combine urban elements with rural creatures in way to have urban lives and function of preservation simultaneously. In ALR these elements are discretionary uses and transportation and utility corridors.

Discretionary uses in ALR could be known as "second land uses" discussed in the first chapter (hypotheses) to assist the survival of the economy and at the same time help farmland preservation.

"If the plan or bylaw is silent on these uses, they are not automatically permitted in the ALR. These include such things as accommodation for agro-tourism, secondary suites, home occupation use, bed and breakfast use and temporary sawmills etc. There are additional uses permitted by ALR regulation, Section 3, including parks, wildlife management areas, roads, railways, water wells etc. which may be permitted or are considered outright uses at the discretion of local government (ALC 2007)."

"Transportation and utility corridors can have significant impacts on individual farm operations and farm communities they pass through. Additionally, roads and highways may act as catalyst, setting off expectations for land use changes that could result in longer term impacts on agriculture. As a result, every effort should be made to avoid agricultural areas with new or expanded routes if at all possible (ALC, 2007)."

According to ALC report on the official website early consultation should take place to seek Commission input where the road in contemplated in the plan and therefore there can be 4 scenarios for building a road in ALR:

The first scenario is that with consultation, various road or utility corridor options may be considered early in the planning process to avoid or minimize impacts on agriculture. In the scenario that a resolution is not reached in time, the proposed route through the ALR should not be included in the plan. Third scenario states that if the plan shows the proposed route, it should also include a disclaimer statement. This statement should be to the effect that the proposed road location is provisional and requires the approval of the ALC where it passes through the ALR. In the fourth scenario policies should include provision for the separation and buffering of trails from adjoining agricultural areas and for early consultation with effected landowners. In this way all the possible situations of destroying the gardens have been predicted and attempted to be prohibited.

ALR can be used for a demand of various types of non-agricultural land uses with early consultation with ALC. In this case, local governments should present enough documents of past and projected growth trends, land demand and supply, and if there are alternative development sites. The local government may need to provide documentation that the specific land fulfills community need that cannot be accommodated outside the ALR. It may also be asked to propose compensating benefits that may be provided for agriculture. But in any case the approval of ALC is needed. This indicates the power of ALC as the main decision maker and the flexibility of the ALR when it comes to necessary urban demands and prepares a balance between all the environmental and development elements in the city.

4.1.4 The policy problem and ALR stakeholders

Four key stakeholder groups would have a strong interest in any change that affects the Reserve; these are the agricultural landowners, environmental and farmland advocacy groups, private land developers and the governmental bodies that manage the Reserve.

"Agricultural landowners are interested in receiving a high price for their land because it is often their most valuable asset. Receiving a high price usually entails selling the land for nonagricultural purposes, which affects the integrity of the ALR. When the Reserve was established, the Farm Income Assurance Act helped compensate agricultural landowners within the ALR for decreases in the value of their land and provided them with income protection. By the time the Province repealed this Act in the 1990s, it was relatively easy for individuals to exclude land from the Reserve. Agricultural landowners are interested in receiving a high price for their land because it is often their most valuable asset. Receiving a high price usually entails selling the land for non agricultural purposes, which affects the integrity of the ALR (Daniels and Bowers, 1997, ch.2 quoted after Cavendish-Palmer, 2008, p.16)."

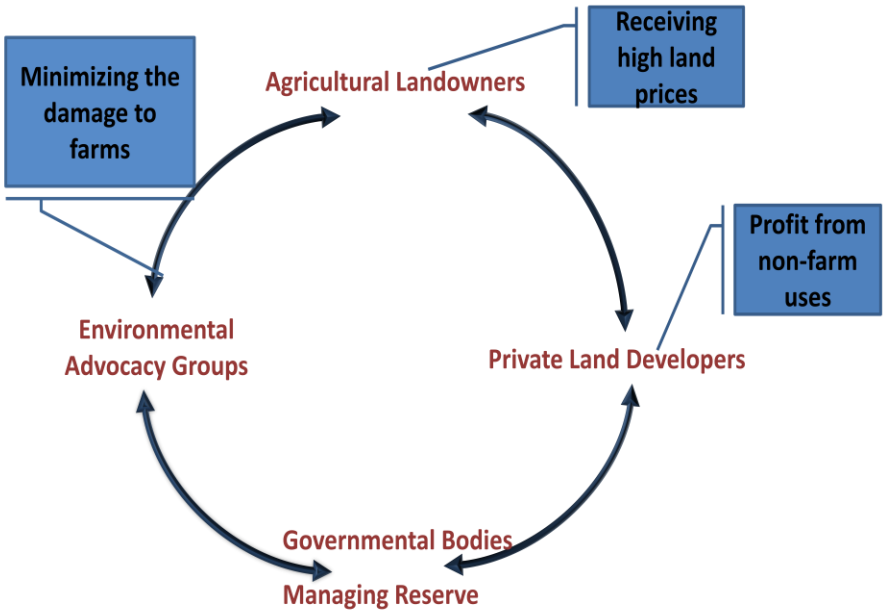
"Environmental advocacy groups are concerned about the status of provincial farmland because they seek to minimize the damages to environmental goods and services that can occur as a result of both urban development and agriculture. However, despite some negative environmental impacts of agriculture, which can include pesticide use and water quality contamination, environmental advocacy organizations tend to favor a strong farmland protection measures (Baxter, 1999 quoted after Cavendish-Palmer, 2008, p.17)."

The David Suzuki Foundation cites food security and the importance of farmland wildlife habitat as two of the central reasons for preserving BC's agricultural land by maintaining a strong ALR (David Suzuki Foundation, 2007, quoted after Cavendish-Palmer, 2008, p.16). Alongside these environmental organizations are groups that advocate for farmland preservation in particular. These include the ALR Protection and Enhancement Committee, the Delta Farmland and Wildlife Trust, and Farm Folk/City Folk (Smart Growth BC, 2007 quoted after Cavendish-Palmer, 2008, p.17). These groups support the existence of a strong ALR and work to raise awareness about farmland among policy-makers and the general public.

Real estate developers are key stakeholders because they potentially profit from the selling of agricultural land for non-farm uses, particularly during periods of rapid population growth (Halseth, 1999 quoted after Cavendish-Palmer, 2008, p.16). "Ultimately, agricultural land decreases the overall profit margin of developers. They are likely to prefer that landowners control land use options for their own property (Cavendish-Palmer, 2008, p.16)."

Finally, the three government bodies involved in *land management decisions* affecting the Reserve have a significant investment in all ALR decisions because any change is likely to affect their mandates directly. Each stakeholder group tracks ALR management policies closely and has some degree of influence over any policy change that occurs (Duke and Lynch, 2006 quoted after Cavendish-Palmer, 2008, p.18). Figure 4.1 shows the stakeholders and their conflicts in farmland preservation process.

Figure 4.1: Farmland preservation stakeholders in BC



Source: after Cavendish- Palmer, 2008

It is the responsibility of the government as a body who manages the whole reserve to try to make balance between the rest three stakeholders' functions by enacting laws and regulations to limit/ control their activities. This does not mean that they will be prohibited from doing their jobs but it means that they should be a higher surveillance on their tasks so that their do not enter each others' territories or have conflicts/ problems with each other. There should be grounds prepared for a suitable environment in the society for land owners to benefit from keeping their lands and environmental supporters to defend them and at the same time land developers to make the city livable by implementing urban projects in the appropriate regions of the city.

4.1.5 Conclusions of BC farmland preservation

Although British Columbia cannot be represented as a very successful preservation example according to statistics, it contains many successful points which can modify a preservation framework and improve the whole function of the preservation system. Although the preservation seems to be an environmental problem, the main issue which led to establishment of ALC stemmed from different social and political situation of that time. This indicates how various elements in a city impact and work with each other so that urban system is able to have optimal function.

In preservation system the same structure is dominant: different management bodies with different duties work together following the same goal which is green preservation. In BC these organizations were MAL, ALC and municipalities which work independently but interrelated and consistent with each other. It has to be mentioned that in the entire system ALC has the highest power and this gives the preservation a big support but despite of this power, it considers the developments which are very necessary for the city demands. Besides ALR has clear, strict and fair rules for entering urban elements in farmlands so that the texture of the farms can be pleasant for urban residents. The permitted land uses have been tried to be compatible with farm activities and with the least green destruction. Next to land uses, the road construction has to be according to exact rules defined by ALC. This shows that preservation is not just about freezing a piece of land but it is also about organizing the related surrounding features which sometimes can destroy a big amount of farm lands although the main farmland parcel is preserved. The details of preservation management structure may be helpful in Iran case.

The legal structure is also similar to the management system; this means that although here are preservation regulations in different management levels, there is a main Act, ALCA which is managed by the main organization, ALC. This act is comprehensive and other regulations which are compatible with it try to complete some details in different urban management levels. Perhaps this structure can work well in Iran as there are so many separated regulations which are incompatible with each other. Therefore a comprehensive act which contains all details regarding preservation can be successful instead of too many small regulations with different approaches and supported by different organizations.

4.2 Quebec agricultural zone

"Québec occupies the north-east part of North America and covers 1,700,000 km². During the last century, the cultivate areas decreased from 2.5 million ha around 1931 to a lower peak under 2million ha in the beginning of the90's. Over the years, yields improved production intensified in parallel with a loss of land due to urban sprawl (Sovoie, 2006, p.2)." "In terms of value of agricultural production, Quebec is the third largest producer among Canadian provinces (Lavoie and Forest, 2009, p.72)."

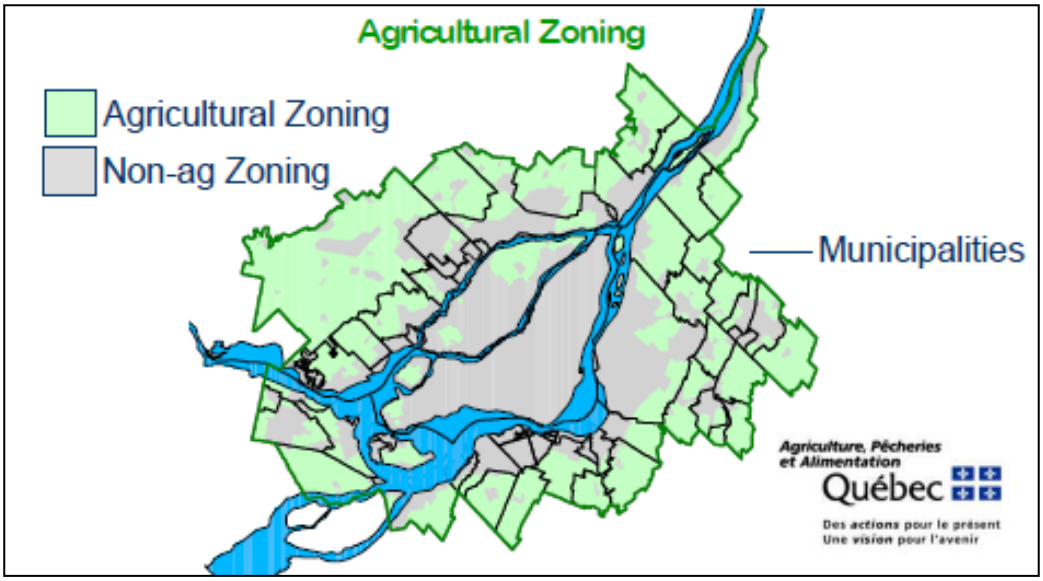
"Croplands make up less than 2% of Quebec's land. They are fragile and non-renewable. The most fertile land is concentrated in Quebec's most densely populated area, namely the St. Lawrence Plain. In fact, over 70% of the total value of agricultural production comes from farms located within a radius of 60 to 75 km of one of Quebec's six large urban centers. As such, they are highly desirable for purposes other than agriculture. Therefore, protecting the agricultural zone and the priority of farming activities in this zone is essential (L'Union des Producteurs agricoles official website 2014)." Quebec agricultural lands' preservation can be seen as one of the relatively successful examples in economic aspects which can be applied in Iran example.

4.2.1 Agricultural zoning

"Agricultural zoning Created in 1978 under the terms of the Act respecting the preservation of agricultural land (LPTA).The Act is managed by the Commission de protection du territoire agricole du Québec (CPTAQ) which recommended the creation of the zoning (Sovoie, 2006, p.14)."

"Quebec's Agricultural Zone is the only reserve in this analysis devoted entirely to farmland. It is also particularly notable because it is one of the only other state or provincially governed agricultural reserves in North America. Figure 4.2 shows the Agricultural Zoning in Quebec according to regulations which Covers an area of 63,500square kilometers. The area of the agricultural zone has remained almost unchanged since the creation of the Commission (Sovoie, 2006, p.13)."

Figure 4.2: Agricultural Zoning, Farmland preservation in Quebec



Source: Sovoie, 2006, p.13

4.2.2 Preservation body managements in Quebec

Similar to British Columbia preservation, in this part the organizations responsible for farmland preservation will be discussed. The goal is to extract the management structure in the city within the literature.

"During the 1960s, soil scientists in Quebec discovered that only two percent of the Province's land area was suitable for agriculture. This finding, in addition to a documented decrease in the number of farms in the province, led to the creation of a Royal Commission of Inquiry on Agriculture in Quebec, which recommended the establishment of an agricultural zone (Tardif, 2004 quoted after Cavendish-Palmer, 2008, p.20)."

"In 1972, at the close of the Quiet Revolution, the UCC (*Union catholique des cultivateurs)* which had been established in 1924 lost its faith-based nature and became the Quebec Agricultural Union/ *Union des producteurs agricoles* (UPA). The UPA of the 1970s and 1980s went to bat on all issues: agricultural zoning and taxation system, regional development, consolidation of the joint plans, remuneration based on actual production costs, harvest insurance, income stabilization insurance, recognition of the role of women in agriculture, support for young farmers, etc. Between 1978 and 1991, the UPA supported the establishment of collective tools (L'Union des Producteurs agricoles 2014a)."

"The provincial government established the agricultural zone in 1978 along with its managing body, the Commission de protection du territoire agricole du Québec (CPTAQ). Each municipality in the province worked closely with the CPTAQ to establish agricultural zone boundaries within their jurisdiction (Glenn, 1985; Government of Quebec, 2007 quoted after Cavendish-Palmer, 2008, p.20)."

The Ministry of Municipal Affairs and Regions (MAMR)/ Ministère des Affaires municipales, des Régions et de l'Occupation du territoire or MAMROT is a government ministry in the Canadian province of Quebec. It is responsible for overseeing the provincial government's relations with all Quebec municipalities, regional governments, the metropolitan areas of Montreal and Quebec City, and the regional administration of Kativik. As it works on the same territory with a different approach, this organization cooperates with CPTAQ to control the urban balance in the territory (Sovoie, 2006, p.16).

The Ministry of Agriculture, Fisheries and Food/ "Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) is a government department in the Canadian province of Quebec. The ministry operates several programs in animal and vegetable production, fishing and commercial aquaculture, food processing and distribution, and storage and retail. The mandate of the Québec Ministry of Agriculture, Fisheries and Food is to influence and support the sustainable development of the Québec food industry. This government body creates, develops, and implements programs targeted toward production, processing, commercialization and the consumption of Québec agricultural, marine, and food products. It also plays an important role in R & D and training (Foods of Quebec 2014).

"In 1989, 12,000 Quebec farmers had already gathered in Ottawa to express their concern regarding the GATT[1] negotiations. In 1992, the UPA participated in the Summit on Quebec Agriculture, during which the government acknowledged the need for altering the farmer assistance programs to meet modern economic conditions. That same year, this work resulted in the establishment of the *Filière agroalimentaire du Québec* to provide better co-ordination of the relationships between the various links in the chain.

"In 1999, during the *Rendez-vous des décideurs*, the UPA put forth the idea of creating an organization administered by representatives of the government and agricultural producers, which would consolidate agricultural insurance, agricultural financing and the other financial tools. After years of work, *La Financière* agricole came into being in 2001 (L'Union des Producteurs agricoles 2014a)." The mission of La Financière agricole du Québec is to support and encourage the development of the agricultural and agri-food sector within a

[1]The General Agreement on Tariffs and Trade was signed in 1947, is a multilateral agreement regulating trade among 153 countries. According to its preamble, the purpose of the GATT is the "substantial reduction of tariffs and other trade barriers and the elimination of preferences, on a reciprocal and mutually advantageous basis (https://law.duke.edu/lib/researchguides/gatt/)."

perspective of sustainable development. In fulfilling its mission, the agency concentrates on the development of the primary sector.

After the foundation of La *Financière* agricole in 2001, feeding the population became a global strategic issue, faced with which the agricultural communities of every persuasion benefitted from working together to find innovative ways of taking action in a market globalization context. It was for this reason that, in 1993, *UPA Développement international* (UPA DI) was founded, a non-profit corporation whose activities included supporting democratic peasant organizations and collective marketing systems in other countries (L'Union des Producteurs agricoles 2014a)."

"MAPAQ (Quebec' Ministry of Agriculture, Fisheries, and Food) and UPA jointly created the autonomous non-profit organization, Agri-Traceability Quebec (ATQ), to start its mandatory program in 2001. ATQ is managed by a board of directors consisting of Government representatives, MAPAQ and FADQ (Quebec's organization that manage agriculture insurance programs) and UPA (representing the agricultural producers). Its chair position is held by a producer. The objective of the partnership was to efficiently integrate both the requirements of the laws and regulations, and the needs of the agricultural producers (such as the simplification of the system for stakeholders, minimization of expenses, and optimization of benefits). Hence, this inter-disciplinary pool of experts, working towards the same purpose, was formed to allow the simultaneous achievement of the two objectives. This is, in fact, clearly stated in the ATQ mission statement as follows: «…to contribute to the improvement of food. From funding perspective, the Government of Quebec, that is also responsible for the laws and regulations on traceability, has granted ATQ a total of $21.5 million over a period of four years (Lavoie and Forest, 2009, p.73)."

"The Quebec Minister of Sustainable Development, Environment and Parks (MSDEP)/Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs or MDDEFP is responsible for the provincial reserves, parks and, environmental policy and land development in the province of Quebec. The ministry is also responsible for implementation of the provincial government's sustainable development plan, of which all provincial government agencies and organizations are party.

Among all of his missions the one relating the content of this dissertation are development, coordination, and implementation of strategies to combat and adapt to climate change; development and implementation of policies, laws, regulations, and programs on Combating and adapting to climate change; Coordination of the government's sustainable development initiative within the public service and Oversight of the enforcement of environmental protection laws and regulations, especially through the analysis of authorization and permit applications, inspections, inquiries, and legal and administrative recourse (Climate Adaptation Knowledge Exchange, 2014)."

The preservation management system can be summarized in figure 4.3. As shown in this figure the entire structure can be divided in to five main categories with different management levels; the first category includes the organizations with the idea of creating agricultural zones and defending its protection consisting Royal Commission of Inquiry on Agriculture and CPTAQ. CPTAQ works with municipalities although it is in provincial level of management. These kinds of links strengthen the connections and interrelationships between different hierarchies so that the gap between the levels will decline.

The second category contains the organizations which are coordinators. The *Filière agroalimentaire du Québec* and MAMR are both operating in a chain as a link between different organizations to generate more compatible function in the network. MAMR works with CPTAQ and also supervises the relations with municipalities on the lower management level. Thus CPTAQ works closely with municipalities in controlling the agricultural zones at local scale, whereas MAMR supervises this relation and work directly with CPTAQ.

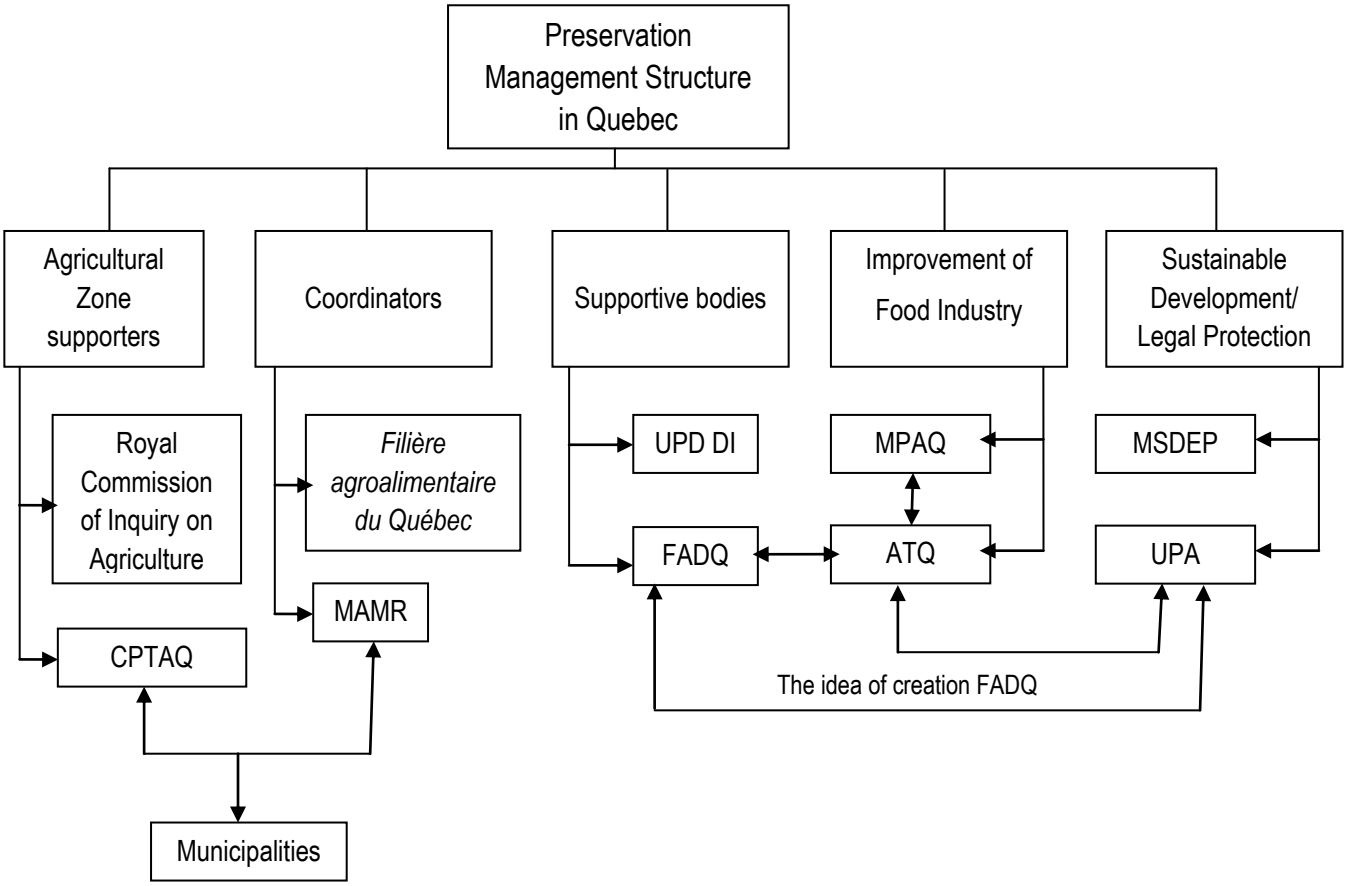
The third type of organizations in the preservation complex are the ones supporting Agriculture financially and by incentives.UPA Development International or UPA DI tries to globalize this support and besides FADQ attempts to support the development of agriculture by consolidating the financial tools for agriculture such as insurance and financing. As explained above UPA had different tasks in the very beginning, hence it put forth the idea of a

separate organization for financial issues of agriculture which led to establishment of FADQ. Any preservation structure needs the supportive component to be sustainable during the time and this task has to be under the supervision of specific independent organizations. In the case of Tehran supporting bodies are either a section inside one organization or charities which are working volunteering; therefore the financial sustainability of the farmers' lives and the agricultural system is not strongly supported. This is the rule: when there is no incentive, there can be no preservation.

The forth group of organizations tries to improve Quebec food industry. ATQ which is financially supported by the government of Quebec works with UPA, FADQ and MPAQ which is the second component of this group focused on sustainable development of Quebec food. Thus preservation is not just about the quantity of farms being preserved but it is also about the quality of food produced by farms. For a country like Iran which has not achieved the first step is hard to take the second one. However the sustainable development of food industry has to be taken in to consideration in designing the optimal system for Tehran which can be achieved in different visions and periods of time in future.

The last category of organizations contains the ones which try to protect environment and Sustainable Development regarding green lands. The UPA developed its character to be more specialized in encouraging the development of agriculture with sustainable development approach during the time. Since it has still different mandates, it works with ATQ and created FADQ. MSDEP which is the ministry of Sustainable Development, environment and parks is thoroughly focused on the rules and policies concerning sustainable development and climate change. Thus it can be also considered as a legal body in the preservation structure as it inspects environmental protection laws.

Figure 4.3: Preservation Management Structure in Quebec



Source: The author

4.2.3 Acts and regulations in Quebec farmland preservation

There are different acts and regulations in Quebec which are the base of farmland preservation and usually there is a social, political or environmental background which brought the law to the table.

"With the Act to Preserve Agricultural Land and Agricultural Activities (LPTAA), brought into effect on November 9, 1978, the goal was to ensure the preservation of the agricultural zones against other undesirable or unjustified uses. This law (LPTAA) was later modified to also protect the activities of agricultural businesses. "The purpose of the legislation is to preserve agricultural land as instituted by the Act is to guarantee a lasting territorial base for agricultural purposes and to foster the preservation and development of farming activities and farm enterprises in the established agricultural zones, in keeping with sustainable development imperatives."In order to give priority to farming activities, the Act controls non-agricultural/ prohibit activities such as residential, commercial, industrial or institutional , cutting maple trees in a sugar bush, effecting a subdivision, alienating a lot and removing topsoil (Summary of the Act, 1999, p.2)."

"It is stated in this Act that the Commission de Protection du Territoire Agricole du Québec manages the Act. The commission is an autonomous, decision-making organization exerting a socio-economic role of the regulation (Savoie, 2006, p.14)." It decides on applications for authorization, supervises the administration of the Act and gives its opinion or advice to the government on matters relating to the preservation of agricultural land and farming activities. This means that it decides for inclusions and exclusions, subdivision, alienation or use of a lot for purposes other than agriculture of the lands in the preserved zone. The application process and the criteria taken in to consideration are exactly clarifies in the content of the act (Summary of the Act, 1999, p.2-10)."

Sustainable Development Act (SDA) is the second act which relates preservation in its context. "In addition to providing a definition of sustainable development, the SDA creates the position of Sustainable Development Commissioner to conduct environmental audits within the office of the Auditor General. The SDA establishes a Green Fund to finance MSDEP[1] initiatives. The fund is financed in part through a levy on fossil fuels (Blakes Lawyers, 2012, P.29)."

However the main environmental statute in Quebec is the Environment Quality Act (EQA) which represents Agricultural Operations Regulation (REA). "The EQA makes it an offence to deposit or allow the deposit of a contaminant into the environment over and above limits set by decree or by regulation or in a manner that negatively impacts on the environment or human health. Accidental releases must be reported to the Ministry of Sustainable Development, Environment and Parks (MSDEP) immediately. The EQA confers upon all persons the right to the protection of the environment to the extent set forth in the Act. A person residing in the immediate vicinity of a place where a violation may occur, the Attorney General, and the local municipality may apply to the Superior Court for an injunction to prevent or stop a violation from occurring or continuing (Blakes Lawyers, 2012, P.24)."

Chapter Q-2, r. 26 of the Act discusses Agricultural matters in the frame of Agricultural Operation Regulation. "The object of this Regulation is to protect the environment, particularly water and soil, against pollution caused by certain agricultural activities. Therefore any human activity on farms, animal breeding, fertilizers, livestock and livestock waste is controlled exactly in to details by the power of this Act (Gouvernement du Québec 2014a)."

The content of the act tries to indicate another approach to farmland destruction. The farms are not just ruined by urban civilization but also agricultural activities which are accomplished on the farms and are dependent on the farms' lives can simultaneously damage the farms and shorten their lives. This negative operation of such activities is very important because of the intuitive function of such activities which is positive in minds. Therefore not so many countries pay attention and have worked on the acts on this debate especially in the third world countries that the main problem is still directly cutting off the trees and destroying green fields, such discussions and rules come in the second step.

[1] The Quebec Minister of Sustainable Development, Environment and Parks

Relating forests the Forest Act is intended to promote sustainable forest management. “It contains different sets of requirements for public and private forests. An authorization must be obtained from the MSDEP pursuant to the Tree Protection Act to destroy or damage a tree, sapling or shrub, or any under wood, anywhere other than in a forest under the management of the MNR[1]. In case of failure to obtain such authorization, punitive damages may be payable (Blakes Lawyers, 2012, P.28).”

“Quebec’s Act respecting the sustainable management of the forest territory became law on April 1, 2010, though most provisions take effect in March 2013. It includes a three-level approach to land use planning, where the forested land base is divided into three types of areas, each with its own level of land use intensity: 1) off limits to resource development (biodiversity conservation); 2) sustainable resource management (multiple use, with a focus on ecosystem-based forest management); and 3) intensive forestry operations (plantation agriculture). Another element is decentralized decision-making by local forest management corporations using results-based management, with MNR taking a step back and concentrating on protecting the public interest, addressing aboriginal issues, road planning, and certain other matters. A further innovation will be selling fiber at market prices, giving existing rights holders a right-of-first-refusal on market-priced lumber (Blakes Lawyers, 2012, p.28).”

There are also regulations defending the farm producers in Quebec. A producer has the right to belong to a syndicate of his choice; he also has the right to belong to a specialized syndicate of his choice provided that it consists of producers engaged in the same form of production as himself. Such membership shall allow him to participate in the activities and management of such syndicate or such specialized syndicate. A syndicate is free to belong or not to belong to a certified association. Every association which wishes to be certified to represent producers must file an application for such purpose to the Board. An association applying for certification must establish, to the satisfaction of the Board and in such manner as the Board considers appropriate, that it represents a majority of the producers of Québec. For the purposes of ensuring itself of its representative nature, the Board may make inquiries among the producers. For any referendum contemplated in this Act to be considered valid by the Board, at least sixty per cent of the producers must avail themselves of the right to vote.

Certification shall confer upon an association the rights, powers and duties.

-to promote, defend and develop the economic, social and moral interests of its members and of the producers and for such purpose act generally as the spokesman for the producers;

-to represent the producers generally as regards the public authorities and any agency, board, commission or group, whenever it is in the general interest of the producers to do so, and cooperate with any organization pursuing similar purposes;

-to conciliate and coordinate the activities of the different federations, specialized federations, syndicates and specialized affiliated syndicates, and of their members and the special interests of the producers with the common welfare of the producers generally;

- to carry out research and studies in relation to the production and marketing of farm products and to any matter which may affect the economic and social conditions of its members and producers;

-to accept the affiliation of a federation or of a specialized federation or, as the case may be, of a syndicate or specialized syndicate;

The expenses of the certified association shall be paid by assessments from the producers and contributions from the federations and specialized federations and from those specialized syndicates which are not members of specialized federations; the contributions may be paid out of the moneys collected by the boards under Chapter IX of Title III of the Act respecting the marketing of agricultural, food and fish products.

The by-law shall determine an annual assessment exigible from each producer by the certified association. Contributions payable to the certified association by specialized federations and by the specialized syndicates may be in a fixed or variable amount according to the nature, importance and extent of the services rendered to

[1] Ministry of Natural Resources

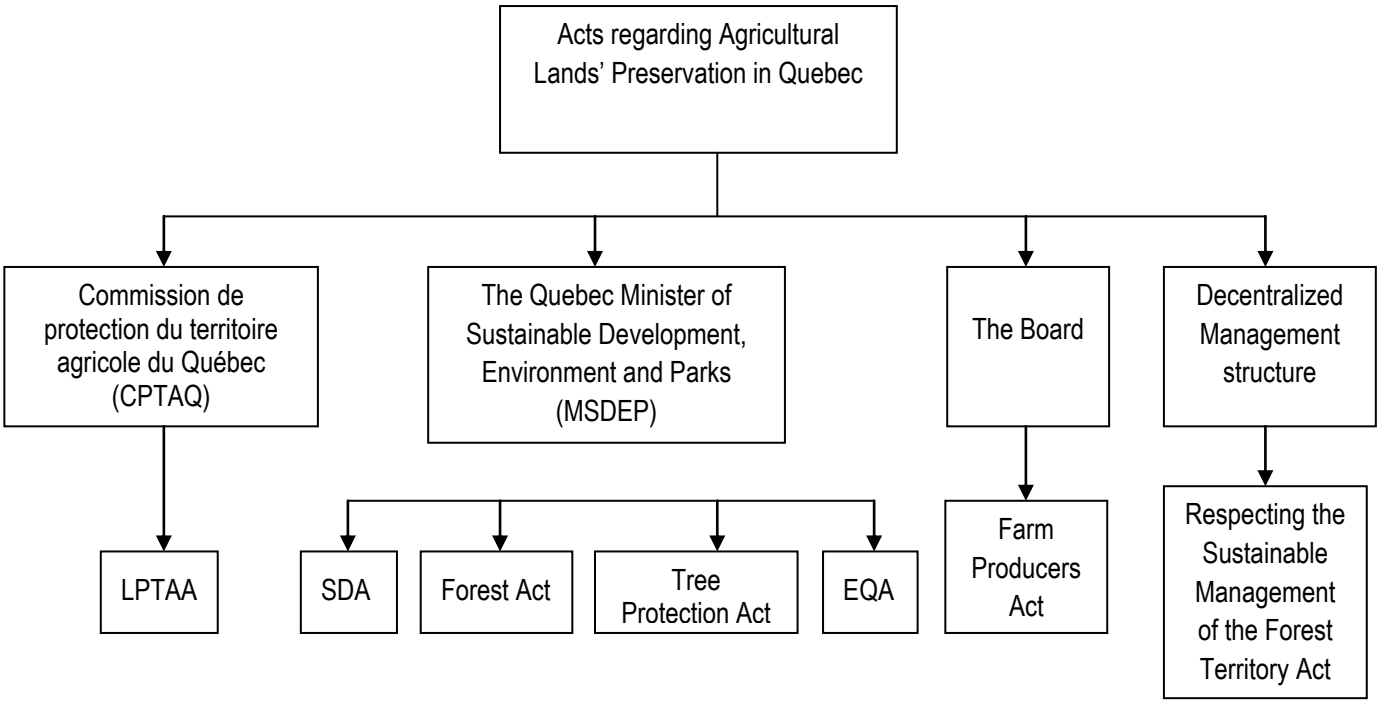
them by such certified association, the number of their members or the number of producers directly or indirectly affected by their activities.

In the case of a board, contributions shall not exceed 20% of the amounts exigible from the producers subject to the joint plan under Chapter IX of Title III of the Act respecting the marketing of agricultural, food and fish products. Every person shall keep a register mentioning the date of purchase and receipt and the quantity of the marketed products or, as the case may be, non-marketed farm products, the name and address of the producer who delivered such product to him, the amounts remitted to such producer and any other relevant information determined by order of the Board. The certified association shall keep, in the manner approved by the Board, registers mentioning the name of all the producers with respect to whom it received assessments during any year. Within three months from the end of its fiscal year, the certified association must, if need be, remit to the producer any amount it received on his behalf during the preceding year and which exceeds the amount of the assessment fixed before (Gouvernement du Québec 2014b).

Figure 4.4 indicates the legal structure of the preservation system in Quebec. As it is shown each act has an organization which is responsible for implementing, supervising or managing the act. As the Quebec Minister of Sustainable Development, Environment and Parks is the crucial legal component of the preservation system, most of the acts are related to this ministry. Moreover Commission de protection du territoire agricole du Québec (CPTAQ) is relatively the strongest decision maker responsible for agricultural lands' preservation and consequently it manages the most significant act relating agricultural lands in Quebec, Act to Preserve Agricultural Land and Agricultural Activities (LPTAA). Farm Producers Act has a specific board which decides for the affairs concerning this act and solves the relating problems. The last act, Respecting the Sustainable Management of the Forest Territory Act has no responsible organization for the moment as its aim is to decentralize the decision- making structure with MNR taking a step back.

The strong connection between the acts and the responsible management bodies reflects an efficient form of a preservation system in which each organization is based on a legal base and each act is implemented, followed or supported by an organization. This makes the structure clear, written in law and easy to follow by citizens and consequently the preservation system will be stronger.

Figure 4.4: Legal Structure of Quebec Preservation



Source: The author

4.2.4 Income security policies for farmers in Quebec

On December 17, 2010, after more than a year of mobilization efforts, the UPA reached an agreement with the Minister of Agriculture that provides for La Financière agricole du Québec (FADQ) to compensate producers affected by the so-called 25 per cent adjustment measure applied to farm Income stabilization Insurance programs (ASRA). Under this agreement, the compensation can be paid from the organization's surpluses, up to the amounts that would have been paid if the measure had not been applied. Throughout the year, to help producers in several sectors faced with an unprecedented cash-flow crisis, the UPA lobbied for a revision of the way the ASRA premium is calculated t ensure that participants pay their fair share.

In June 2011, the National Assembly Commission on Agriculture, Fisheries, Energy and Natural Resources (CAPERN) began its mandate to examine the FADQ's orientations, activities and administration. In the course of this work, the UPA prepared a profile of the financial difficulties of agricultural producers and suggested several possible solution paths. On October 4, officials of the Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) tabled new support measures. Here are the highlights:

• Changes to the rating methodology of the ASRA program, resulting from an actuarial revaluation;
• Staggering the application of the efficiency measure (the so-called 25%) in the hog sector;
• Increasing the principal eligible for interest repayment from $100,000 to $150,000 per farm operation under the Farm Operation Adaptation Support Strategy;
• Implementation of special assistance for farm operations experiencing critical financial difficulties;
• Faster intervention by the Agri-Québec program starting in 2012;
• Regular MAPAQ follow-up with the UPA and affiliated groups; Although these measures are a step in the right direction, they remain insufficient to meet the current cash-flow needs of hog operations. The UPA is continuing its demands to the FADQ to further reduce premiums in this sector (L'Union des Prodecteurs agricoles, 2014 b).

4.2.5 Conclusions of Quebec farmland preservation

For the very first time the idea of creating an agricultural zone in Quebec started from 1960s with Royal Commission of Inquiry on Agriculture. The whole management system of preservation in Quebec has its very beginning core in Quebec Agricultural Union or UPA which at the time of establishment had many different mandates from social to economic and surveillance. This can be compared to the current situation of municipality in Tehran with various tasks and unorganized system. Yet as time goes on these separate tasks were distributed among different organizations and became more specialized to form an optimal framework for a preservation structure with categorized departments. Although the organizations try to become more specialized in one field relating preservation, they all follow one goal and are interrelated with each other as shown in Figure 4.2.

The outstanding point in Quebec case study is that the supportive body is relatively strong and the agriculture is not just considered as preservation of a piece of land but it expands its boundaries to the sustainability of the preservation and the harvest it yields. With sustainability two terms are meant: sustainability of the preservation with enough financial resources and incentives and also the sustainability of the food produced on the piece of farmland. The first type of sustainability should be achieved by the society to proceed to the second type. In Iran case the there are still barriers to implement the first type. Iran preservation system still needs supportive organizations designated to financial and socio-cultural protection for agriculture.

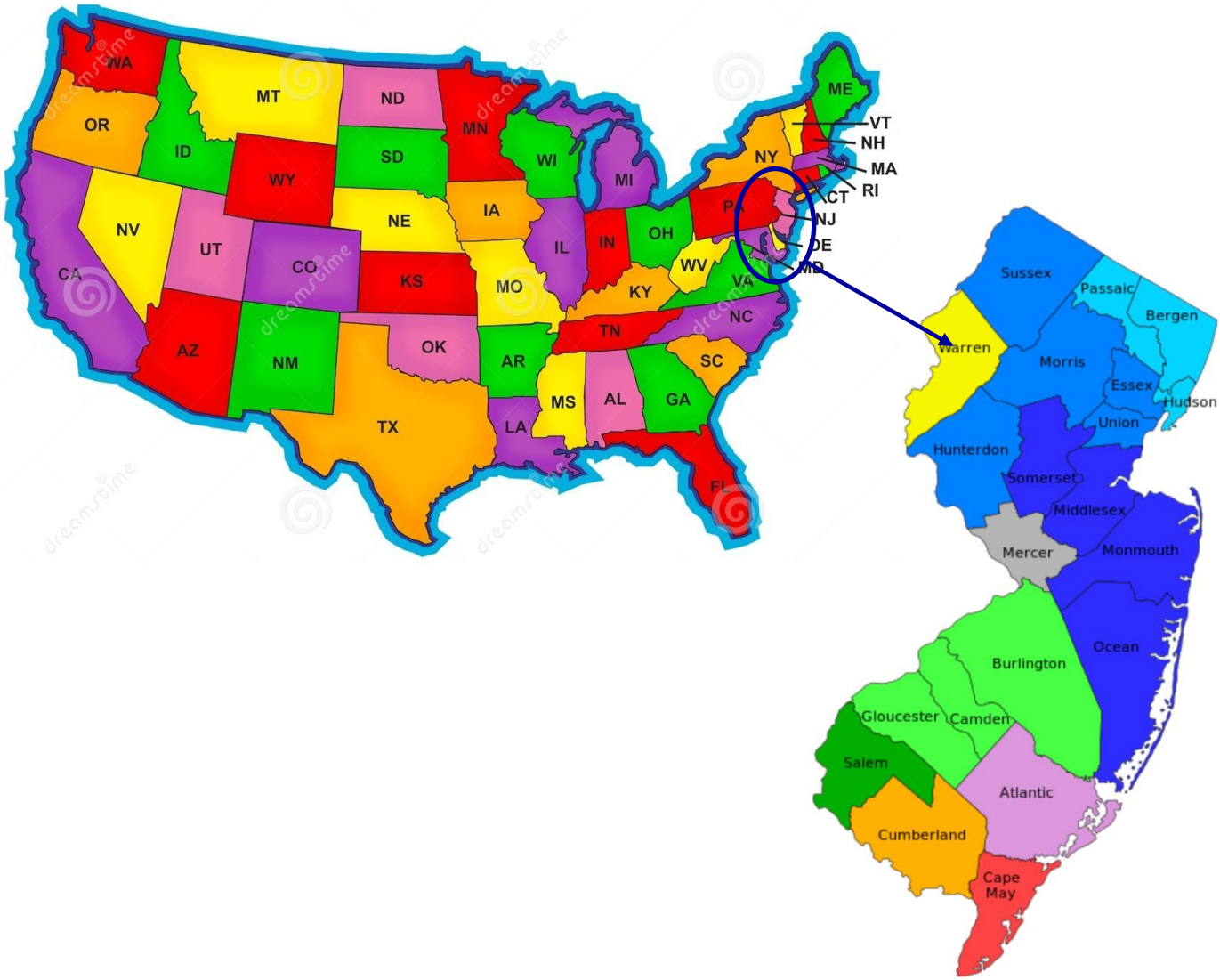
The legal structure is connected to the management structure so that the most crucial preservation act is managed by APTAQ which is the most significant organization regarding agriculture preservation in Quebec. As MSDEP is the main organization responsible for regulations and policies, most of the acts have to be implemented or followed by this ministry. Therefore the management structure is not any phenomenon apart from legal structure. These two elements can develop an unsurpassed preservation structure when they the content of the acts are supported by the organizations and the organizations' tasks are defined according to the written acts. In the case of Quebec although there might be some deficiencies such as giving various responsibilities to UPA

but this structure seems to work well as it is following the organization-act rule and this rule is exactly what is missing in Iran case.

4.3 Township of Frelinghuysen in Warren[1]County

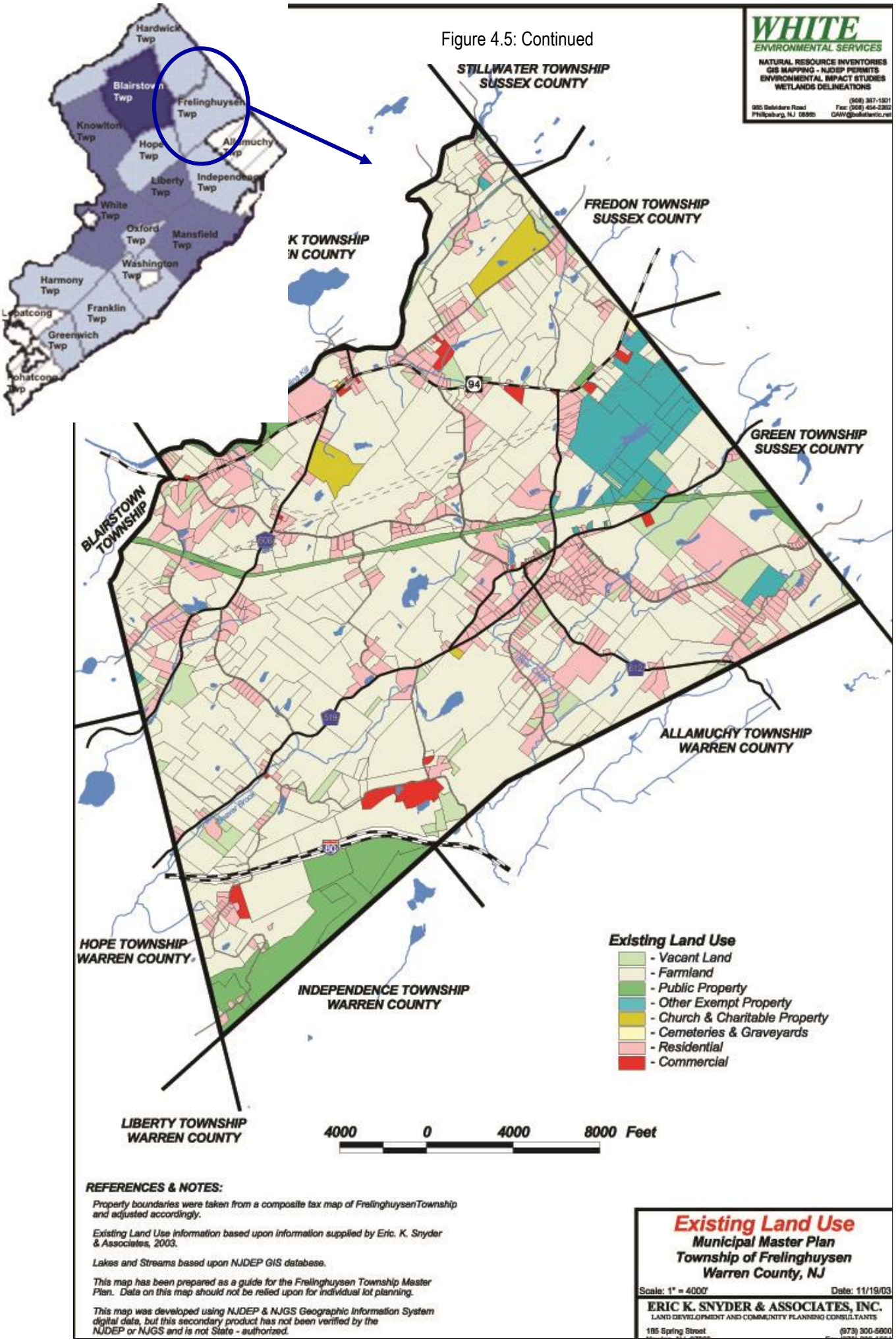
Frelinghuysen Township in Warren County of the state of New Jersey (as shown in figure 4.5) boasts an impressive variety of dairy farms, crop fields, nurseries, and woodlands. It is the second largest agricultural land base in Warren County, and more than two-thirds of the Township is assessed as farmland. Frelinghuysen Township has aggressively pursued and supports the preservation of its agricultural lands. Over *1,433 acres* of farmland has been permanently preserved within its borders. Frelinghuysen administers an Open Space and Farmland Preservation Trust Fund ($0.02/$100 assessed value) that helps fund farmland protection, and developed a *Comprehensive Farmland Preservation Plan* in 2005 to guide expenditures from the Trust. The Township has also set the ambitious goal of preserving an additional: 100 acres in 2008, 500 acres by 2013, and 1,000 acres by 2017.

Figure 4.5: Location of New Jersey in US, Warren County in the state of New Jersey, Frelinghuysen in Warren County and the existing Land use of Frelinghuysen



[1]The data for this section has been derived and analyzed from Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen- County of Warren (since it is a complete source, taking all the aspects of preservation in to consideration). Where another source is used, it would me mentioned.

Figure 4.5: Continued

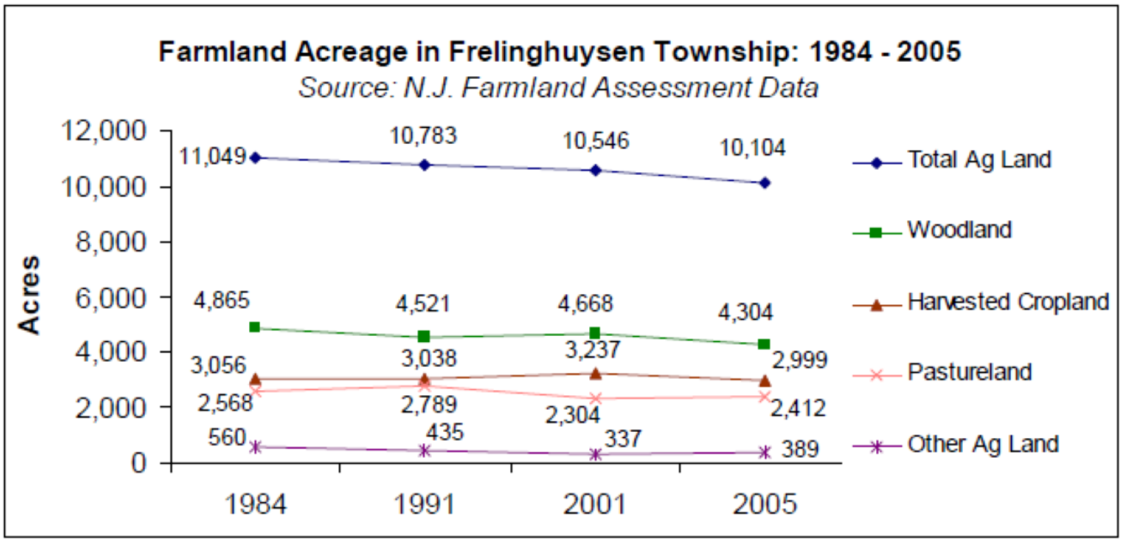


Source: Frelinghuysen Master Plan 2007, Township of Frelinghuysen

As seen Frelinghuysen Township is a community that is identified by its beautiful natural resources and rich agricultural lands. Its 15,276 acres offers residents a varied landscape of mountains, valleys, rivers, marshes, rock ledges, and rolling farmland.

There were three main issues and some sub-issues leading the urban authorities to think about the farmland preservation in Frelinghuysen. The first one is shown in figure 4.6.

Figure 4.6: Farmland Average in Frelinghuysen Township from 1984-2005



Among the factors contributing to this trend of decreasing farm is the declining acreage of farmland in Frelinghuysen Township. Frelinghuysen has lost nearly 1,000 acres of farmland (9%) since 1984. While losses were observed among all types of agricultural land uses, the most significant losses occurred within the woodland category, which includes both attached and unattached forested areas. "Other" agricultural lands, such as farmhouses and support structures, experienced the greatest percentage decrease during this time (30%). The American Farmland Trust found that, "*Every single minute of every single day America loses two acres of farmland*."

-*The second problem* stems from farmland parcel size: Agriculture is the predominant land use in Frelinghuysen Township. There are currently 216 farm parcels that cover 10,104 acres of the Township but the average size of operating farm units in Warren County decreased during the time. This process is shown in table 4.1.

Table 4.1: Farmland Average in Frelinghuysen Township from 1984-2005

Average and Median Farm Size, Warren County, NJ				
	1987	1992	1997	2002
Average Farm Size	132	128	114	96
Median Farm Size	NA	NA	37	31

-*The third problem* has its roots in population growth. The population and residential housing stock in Frelinghuysen has nearly doubled since 1970. Land in Frelinghuysen is growing increasingly desirable as

indicated by land value trends over the past ten years (Easement Value[1], Figure 4.7 below). Consequently, population projections from the Warren County Planning Department anticipate that the population of Frelinghuysen will increase almost 40% by 2030 (see Population figure 4.8 below).

Figure 4.7: Per Acre Easement Value of preserved farms, Frelinghuysen Township, 1997-2007

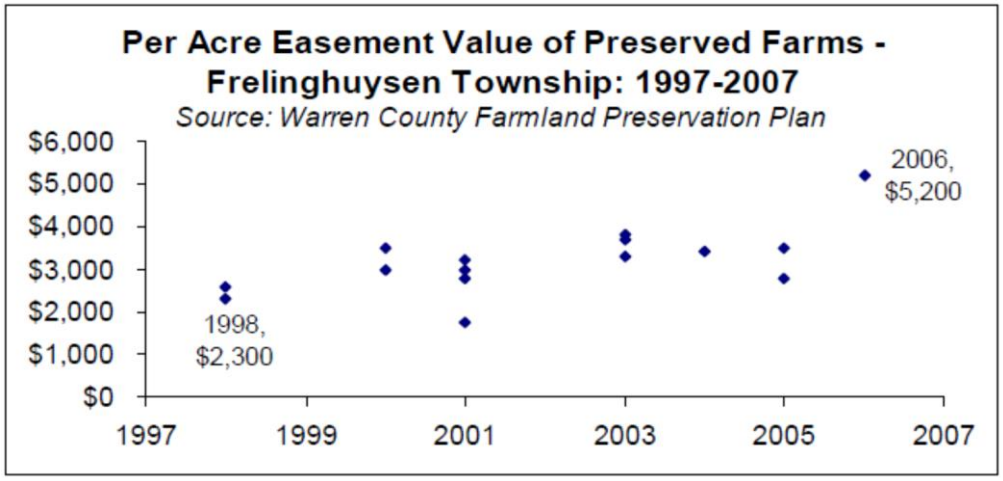
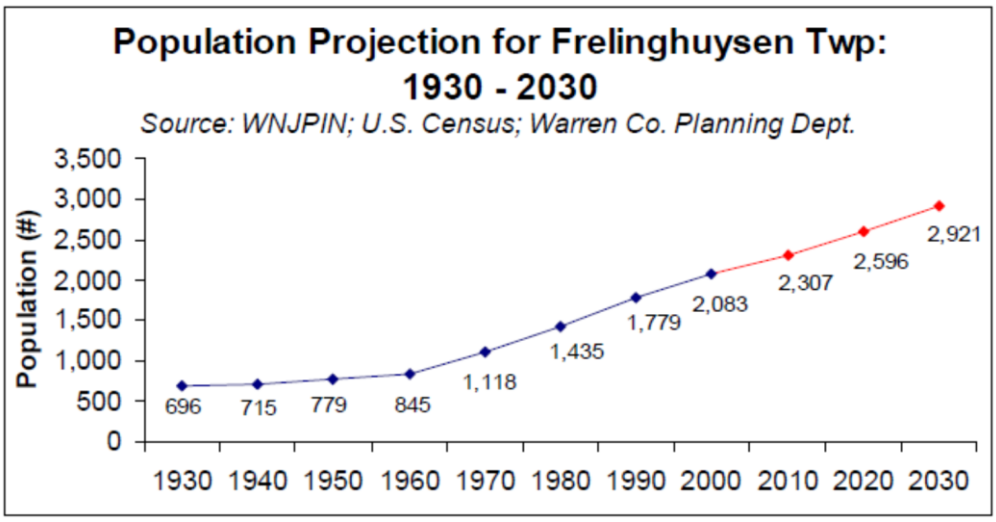


Figure 4.8: Population projection in Frelinghuysen Township, 1930-2030



-*The fourth problem* is land use conversion. In spite of these mounting growth and development pressures, Frelinghuysen remains a pleasant rural community. Analysis of NJDEP Land Use/Land Cover data between 1986 and 2002 shows that some forested areas have been converted to farmlands and that some farmlands have been developed or become barren (compare figures 4.9 to 4.11*)*.The vast majority of the Township has been retained in an agricultural or natural state.

As seen in above figures, the light blue/gray parcels have increased from 1986 to 2002. They have increased either directly from brown parcels which means that agricultural lands have turned into urban development or there is a pink/ yellow phase in the middle which shows the transformation of agricultural lands first into barren lands and then to urban settlements.

[1]In the United States, a conservation easement (also called a conservation basement, conservation covenant, conservation restriction or conservation servitude) is a power invested in a qualified private land conservation organization (often called a "land trust") or government (municipal, county, state or federal) to constrain, as to a specified land area, the exercise of rights otherwise held by a landowner so as to achieve certain conservation purposes.

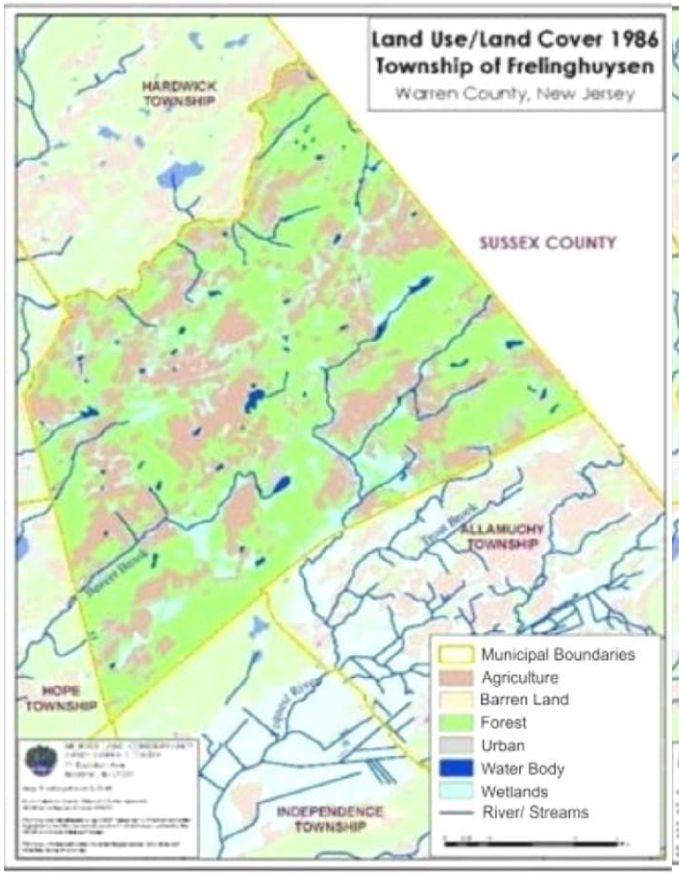


Figure 4.9: Land use of Frelinghuysen 1986

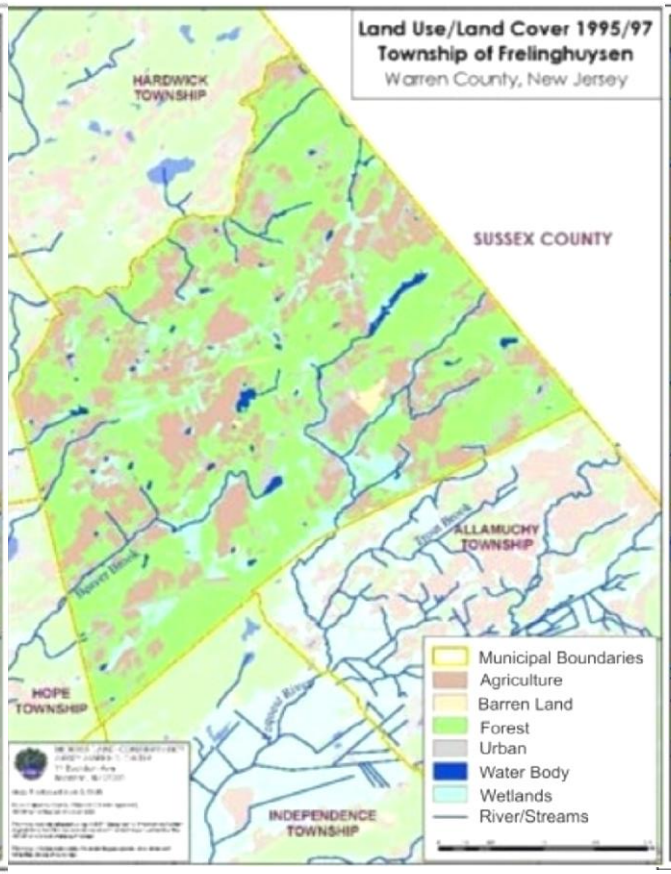


Figure 4.10: Land use of Frelinghuysen 1995/97

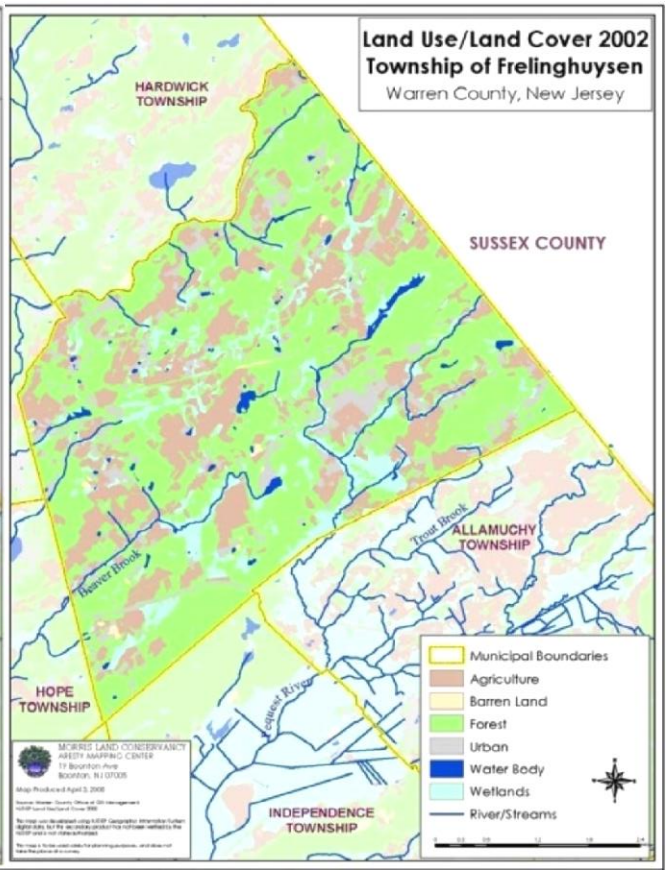


Figure 4.11: Land use of Frelinghuysen 2002

Thus, the area of barren lands in 1995 is more than two other figures, before this time barren lands were farmlands and after they turned to dwellings. This process can easily be recognized in south east of Frelinghuysen. In some parts the new urban parcels shown with light blue have appeared during the mentioned time and in some other the existing urban developments have spread their boundaries. The second category can be observed more on the lands around the river. The number of parcels changing from agricultural lands to urban development is more than the ones from forests. Therefore the amount of forests in 2002 is closer to the one in 1986 than the number of agricultural lands.

4.3.1 Urban preservation plans as a solution

Land use planning efforts at the state, county and local levels have aimed to minimize the impact of new development on the agricultural industry. The *State Development and Redevelopment Plan* designated all of Frelinghuysen Township as Rural, Environmentally-Sensitive, or Parklands, and encourages concentrating new growth within existing developed areas in order to preserve the County's rural environs. Warren County's recently released *Strategic Growth Plan* also advocates development clustering, smart growth practices, and land preservation to advance similar objectives. The Township has recently modified its zoning densities to reflect the agricultural, center-based landscape it wishes to resemble in the future.

This 2008 Comprehensive Farmland Preservation Plan restates the Township's emphasis on farmland preservation. It serves an update to the Township's 2005 Farmland Preservation Plan, and brings the Township's farmland preservation planning efforts into compliance with revised SADC[1] guidelines. As part of this process, the 2008 Comprehensive Farmland Preservation Plan identifies the seven Project Areas that are the basis for future farmland preservation efforts in Frelinghuysen (More details in see section 4.3.18). The Township has also set the ambitious goal of preserving an additional: 100 acres in 2008, 500 acres by 2013, and 1000 acres by 2017. Moreover Frelinghuysen Township is committed to permanently protecting 2,433 acres of farmland within the next ten years.

There are many innovative ways to promote the longevity and sustainability of agriculture in Frelinghuysen Township. Efforts to support "value-added" products such as organic and processed goods promise to make individual operations more profitable. Frelinghuysen has enacted a Right-to-Farm ordinance and established a municipal Planning Incentive Grant (PIG) program in order to bring state dollars for farmland preservation in to their community. Strong actions like these show support for the practice of agriculture and indicate a willingness to cooperate with State and County initiatives in order to maintain local farms.

4.3.2 SADC responsibilities as the main preservation body in Frelinghuysen

SADC as the most important body in Frelinghuysen preservation system has to provide cost share funding for the purchase of development easements; Directly purchase farms and development easements from landowners; Administer grants to landowners in the Farmland Preservation Program to fund up to 50 % of soil and water conservation projects; Administer the Right to Farm Program; Administer the Transfer of Development Rights Bank; and operate the Farm Link Program, which helps connect farm owners with potential tenant farmers.

4.3.3 New Jersey Department of Agriculture (NJDA) as a supporting body

The State of New Jersey offers Frelinghuysen farmers a number of support agencies and programs ranging from technical advice to farm loans. The New Jersey Department of Agriculture (NJDA) Smart Growth Tool Kit provides information to support municipal governments, businesses, non-profit groups, and local citizens in their efforts to achieve the goals and objectives outlined in the NJDA Agricultural Smart Growth Plan for New Jersey, 2006. (Agricultural Smart Growth Tool Kit) (Agricultural Smart Growth Plan 2006) The Tool Kit embraces the five components that have been identified by NJDA as critical for the future of farming: Farmland Preservation,

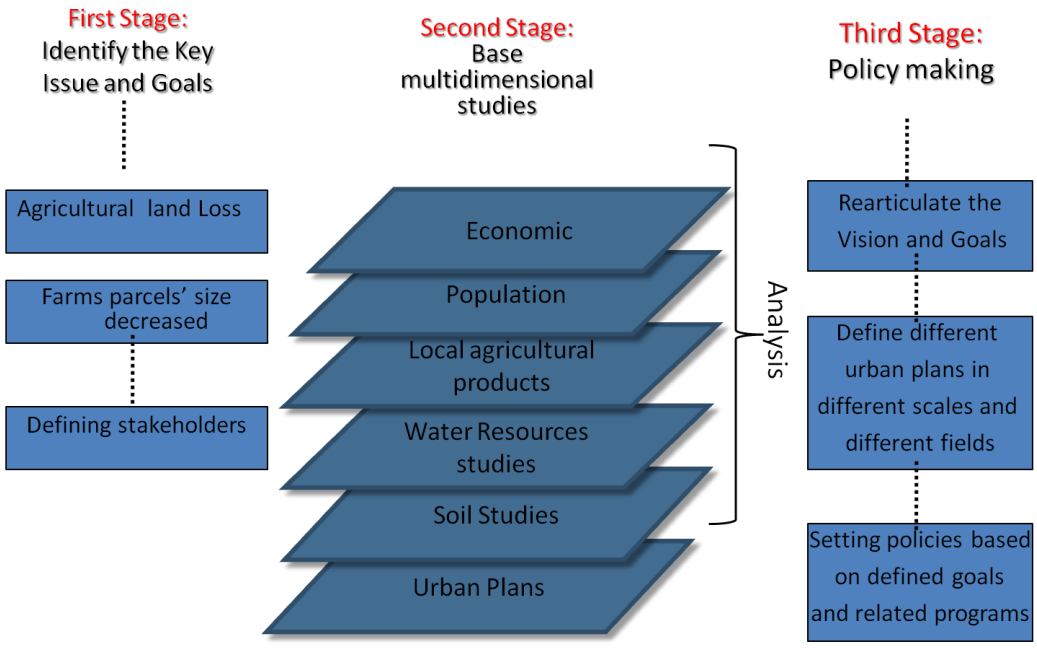
[1] State Agriculture Development Committee

Innovative Conservation Planning, Economic Development, Agriculture Industry Sustainability, and Natural Resource Conservation.

4.3.4 Frelinghuysen preservation plan process

Through going forward preservation in this plan, different multidimensional studies have been implemented to prepare the ground for analysis and to have a system thinking approach to the whole problem in the township. As the detailed information of such studies would be irrelevant with the content of this dissertation, here the author avoid the chapter and tries to illustrate the process and the name of the studies done by the plan. Figure 4.12 shows the three main stages illustrated by the author which indicates the whole process of the plan. At the first stage the problem has been identified which is also reviewed previously in the current research. At the second step the basic studies about water resources, population trends, soil quality, local products (milk, hey, corn…) and urban plans were accomplished and analyzed. At last the final policies were based on the whole process of multidimensional studies in the second stage and the vision derived from the first stage. Figure 4.13 indicates a brief overview on the content of the whole multidimensional-basic studies on second stage (already shown in figure 4.12) of Frelinghuysen preservation plan.

Figure 4.12: The Process Preservation plan in Frelinghuysen, after Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen- County of Warren



Source: After Comprehensive Farmland Preservation Plan 2008, Township of Frelinghuysen- County of Warren

As in this section of the research the process of producing a successful preservation plan should be reviewed and analyzed and not the details, it ought to be mentioned that the preservation plan is a kind of urban plan, therefore it cannot be acceptable without geo-data or maps which classify the different qualifications of the working field. In Frelinghuysen these maps have been summarized as figure 4.14.

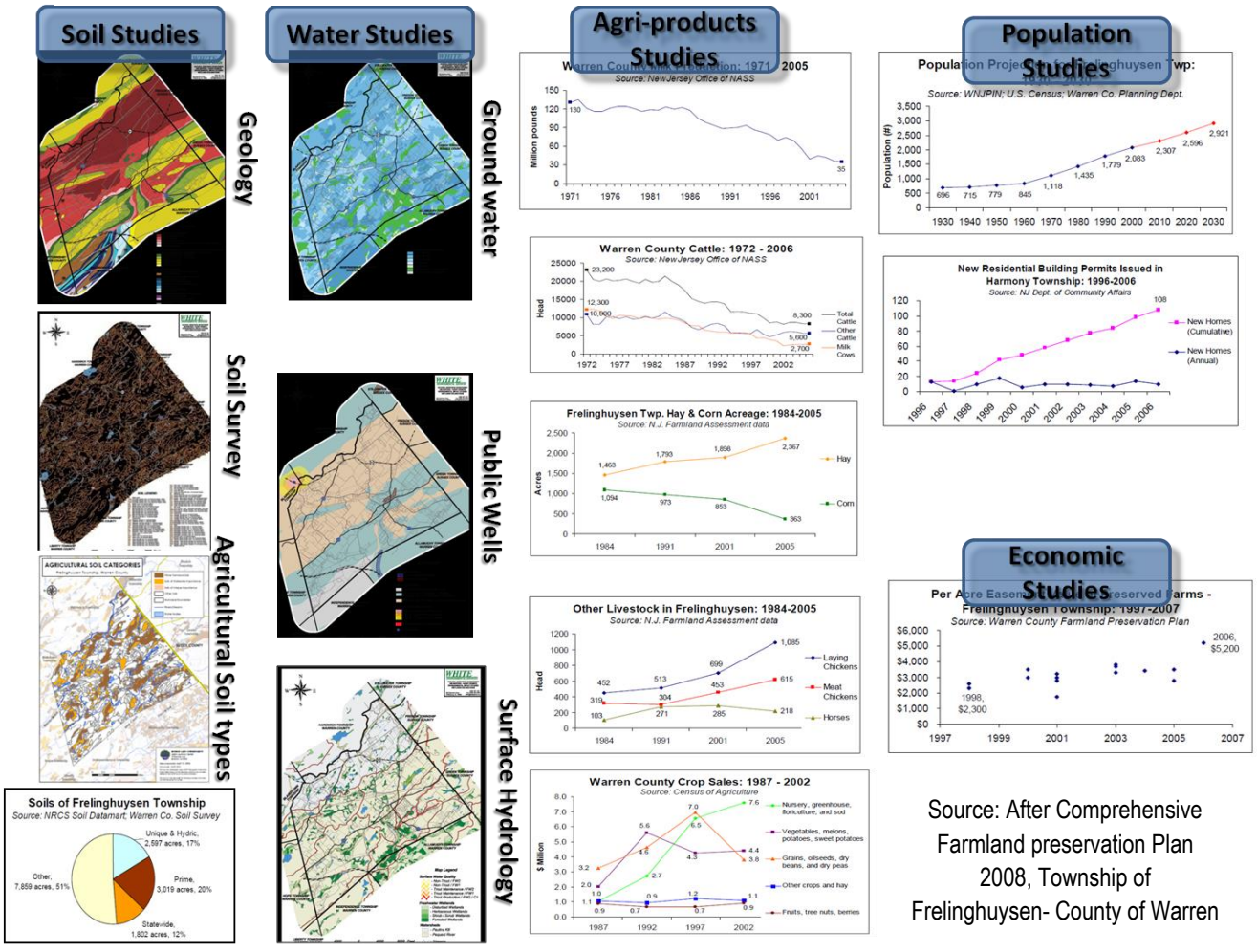
As shown above, five different studies were conducted simultaneously to prove the importance of research and also as basic studies to simplify the research process on preservation. A hug investigation has been accomplished in the field of geology and to categorize the soil types. Water resources have been studied in three groups of surface water, ground water and wells.

Figure 4.13: Multidimensional basic studies at the second stage of farmland preservation plan in Frelinghuysen

Soil	Water resources	Local agricultural products	Population	Economic (Easement Value)
Geology and soil council for development and agriculture	Adequate rain is important for growing crops	Dependency of residents to farms preservation	The correlation of growing population and their need to local products	A power invested by government or land trust to achieve conservation purposes
16 types of prime farmland soils	Annual precipitation of 48.3 inches	Milk products Cattle, hay, corn, livestock…	Increasing trend in population and therefore in residential permits	Easement value increased twice from 1998 to 2006
Natural resource Conservation service	Not sufficient artificial irrigation, Groundwater preferred to surface waters ,less sediment and particulates		Population in 2030 with 40% increase and service by government should increase	

Source: After Comprehensive Farmland Preservation Plan 2008, Township of Frelinghuysen- County of Warren

Figure 4.14: Multidimensional basic studies and provided maps at the second stage of farmland preservation plan in Frelinghuysen



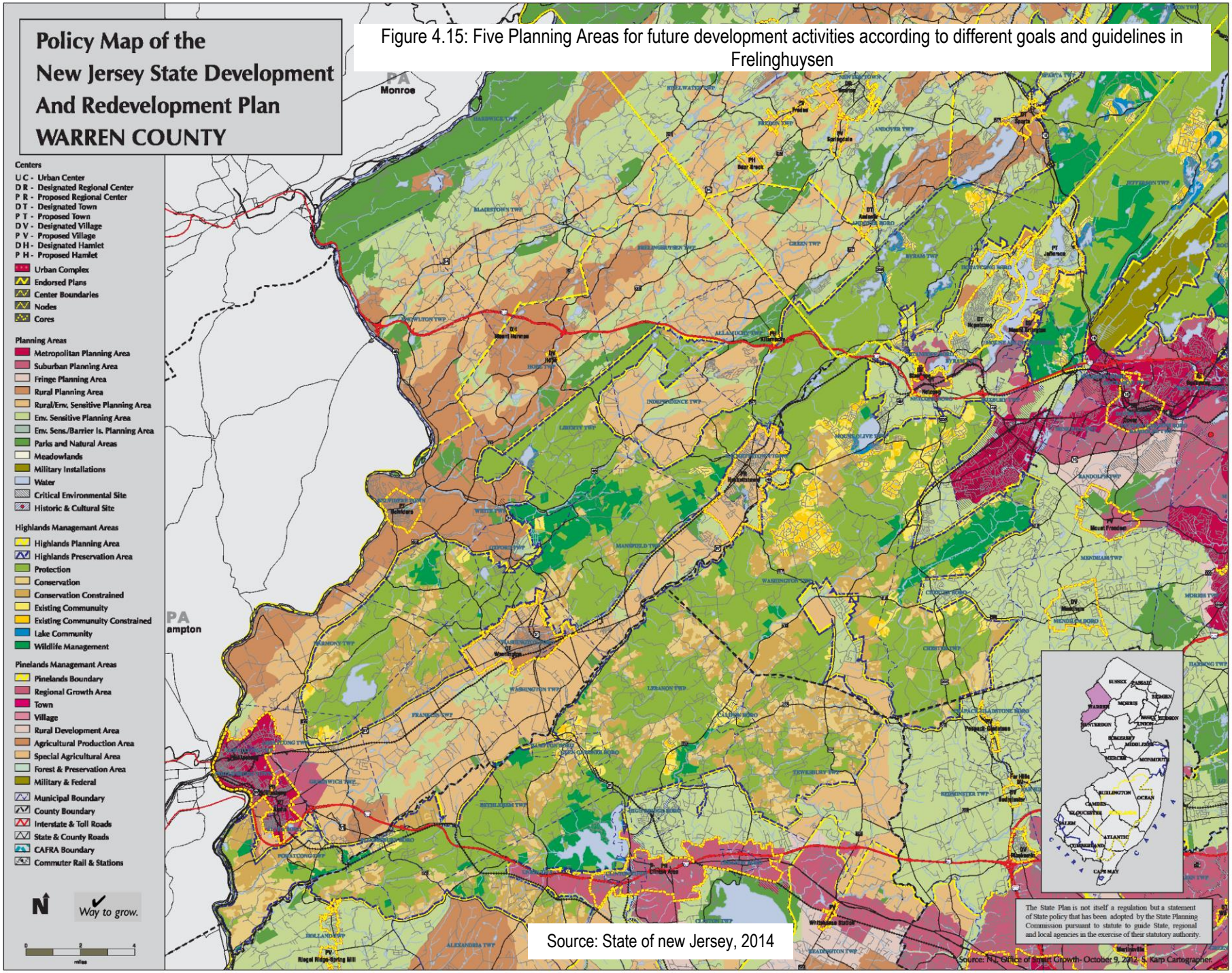
Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen- County of Warren

increase in the population and naturally their needs and consequently the economic requirements were also the very first parts of the project. In the case of Frelinghuysen a big attention has been paid to agricultural yields and the need of people in the township to these products. This is a new approach to highlight the importance of farmlands even in urban lives which is not still followed by urban planners in Iran. In Iran preservation projects the environmental aspects are very strong, although the need to farmlands in the cities should not only be justified by discussing about air pollution problems and the lack of urban green spaces. Perhaps opening the topic regarding the fast population growth in Tehran and how to provide their needs can emphasize the necessity of conserving green lands in Iran better.

4.3.5 State Development and Redevelopment Plan

The New Jersey State Planning Commission drafted the *State Development and Redevelopment Plan (SDRP)* to outline general policy objectives concerning land use and future development in the State. The SDRP identifies five Planning Areas where different sets of goals and guidelines are considered appropriate to determine future development activities. (See *Planning Areas Map,* figure 4.15 below) These Planning Areas are labeled as Metropolitan, Suburban, Fringe, Rural, Rural-Environmentally Sensitive, Environmentally Sensitive and Park. Frelinghuysen Township only contains Rural, Rural-Environmentally Sensitive, Environmentally-Sensitive, and Park planning areas. Environmental sensitive areas are the biggest category with 45 % of the whole planning areas whereas parks only cover 3% of the area. Rural-Environmental sensitive lands are about 40% and at the second place and rural areas with 12% at third. The SDRP also identifies Designated Centers where future development and redevelopment activities are most appropriate and will be actively promoted. Centers are categorized as Urban Centers, Regional Centers, Towns, Villages, and Hamlets corresponding to criteria including size, regional location, population, residential and employment densities, and available housing stock. The combination of Planning Areas and Designated Centers establishes a comprehensive framework for pursuing land use and development regulation throughout New Jersey.

Figure 4.15: Five Planning Areas for future development activities according to different goals and guidelines in Frelinghuysen



Source: State of new Jersey, 2014

4.3.6 Highlands Regional Master Plan

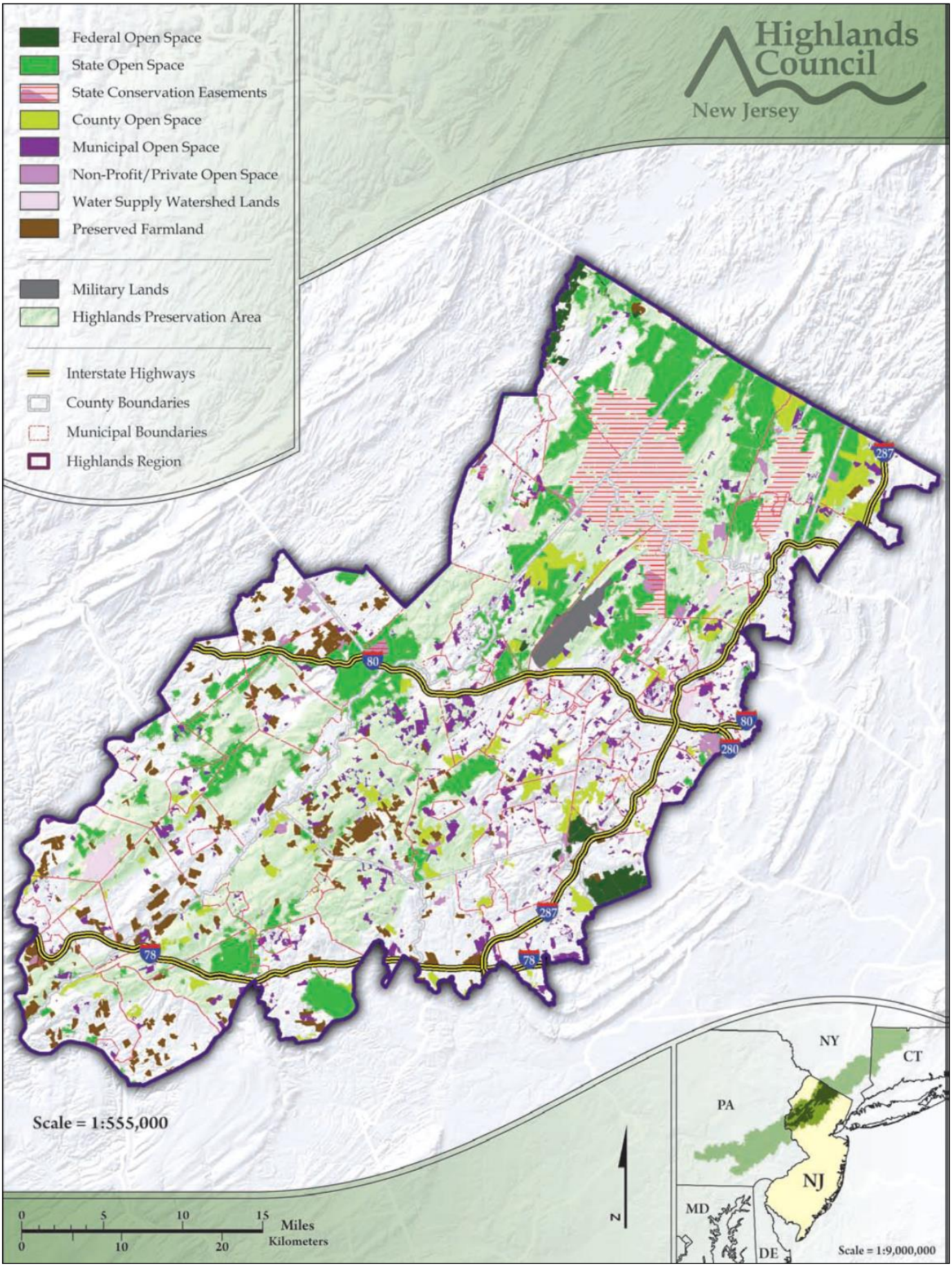
The New Jersey State Legislature enacted the Highlands Water Protection and Planning Act on August 10, 2004. In an effort to ensure the integrity of the northern New Jersey's drinking water resources, the Highlands Act imposes strict land use controls over large parts of the 88-municipality region, known as the Highlands Preservation Zone. Areas within the Preservation Zone are subject to heightened restrictions on development, water use and activities that affect water quality or environmentally sensitive lands. The Act expands mandatory buffers around the region's streams and water bodies, sets limits on impervious coverage for individual properties and requires master plan conformance from Preservation Area municipalities, among other criteria. Frelinghuysen Township is not subject to these new requirements because it falls entirely within the Planning Area of the Highlands Region.

The preservation of open space and farmland has been and continues to be an important public policy initiative supported time and again by the citizens of New Jersey. The November 2009 action by the electorate to approve a referendum $400 million for open space, farmland, flood-prone land, and historic preservation activities is a continuation of past practices as New Jersey voters have approved twelve similar bond acts going back to 1961. As of the adoption of the Highlands Regional Master Plan (RMP) in July 2008, a total of 273,457 acres of the Highlands Region were identified as open space or preserved farmland. (Figure 4.16)

4.3.7 Agricultural priority zones

The Highlands Council also identifies Agricultural Priority Areas– subsets of the larger Agricultural Resource Area (Figure 4.17) that are particularly well-suited to agricultural production. Criteria used by the Highlands Council to delineate these areas include soil quality, tillable acreage, buffers, development potential, local commitment, contiguity with other farm parcels and size. (*Highlands Sustainable Agriculture Technical Report*) High, medium, and low priority areas cover most of Frelinghuysen Township's land area outside Johnsonburg and Marksboro. (Figure 4.18) The resource value of agricultural lands was developed by utilizing ranking criteria from the New Jersey Department of Agriculture (NJDA) SADC Farmland Preservation Program and the County Agriculture Development Board (CADB) farmland preservation programs.

Figure 4.16: Highland Preserved lands in Highlands Regional Master Plan 2008



Source: Jew Jersey Highlands Council, 2014

Agricultural Resource Area

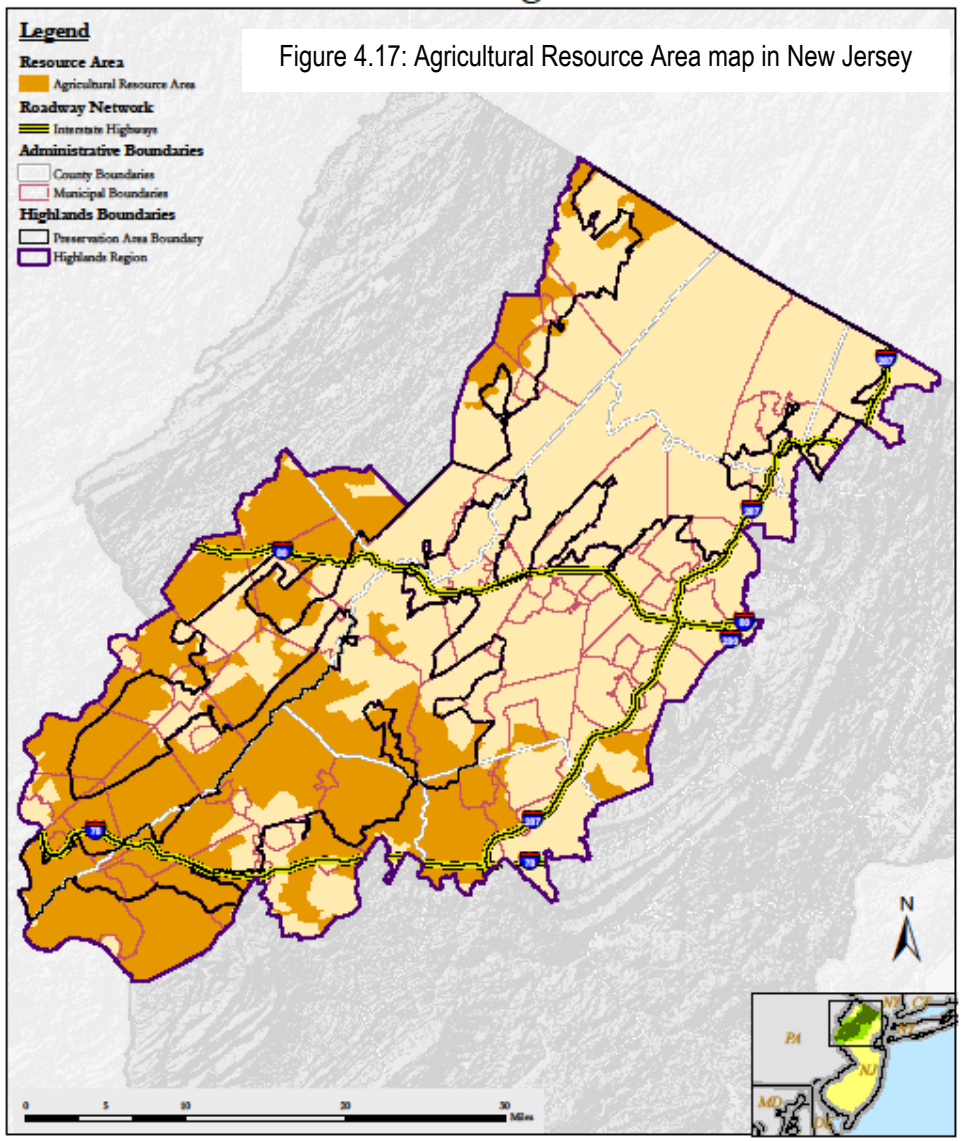


Figure 4.17: Agricultural Resource Area map in New Jersey

The Highlands Council makes no representations of any kind, including, but not limited to, the warranties of merchantability or fitness for a particular use, nor are any such warranties to be implied with respect to the information contained on this map. The State of New Jersey shall not be liable for any actions taken or omissions made from reliance on any information contained herein from whatever source nor shall the State be liable for any other consequences from any such reliance. Additional sources of information may include NJDOT and NJDEP GIS digital data, but this secondary product has not been verified by NJDOT or NJDEP.

Highlands Regional Master Plan
Final Draft, November 2007

Highlands Council
New Jersey

Sources:
New Jersey Highlands Council, 2006

Agricultural Priority Area

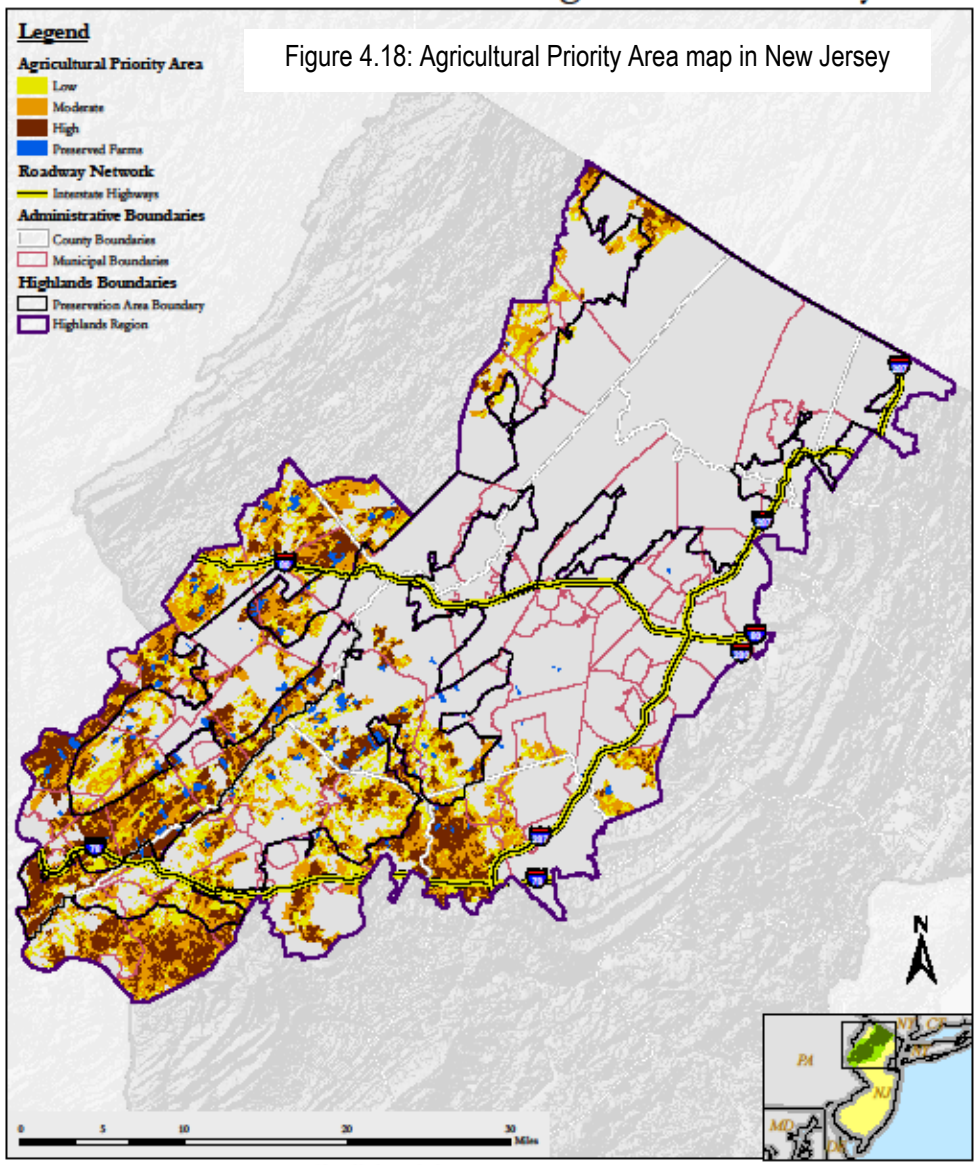


Figure 4.18: Agricultural Priority Area map in New Jersey

The Highlands Council makes no representations of any kind, including, but not limited to, the warranties of merchantability or fitness for a particular use, nor are any such warranties to be implied with respect to the information contained on this map. The State of New Jersey shall not be liable for any actions taken or omissions made from reliance on any information contained herein from whatever source nor shall the State be liable for any other consequences from any such reliance. Additional sources of information may include NJDOT and NJDEP GIS digital data, but this secondary product has not been verified by NJDOT or NJDEP.

Highlands Regional Master Plan
Final Draft, November 2007

Highlands Council
New Jersey

Sources:
New Jersey Highlands Council, 2007
State Agriculture Development Committee, 2006

Source: New Jersey Highlands Master Plan, New Jersey Highlands Council, 2014

4.3.8 Frelinghuysen Township master plan

The Farmland Preservation program, as implemented in Frelinghuysen Township, is consistent with and will assist in the implementation of many specified municipal goals. Frelinghuysen Township's *Master Plan* has identified the following goals pertaining to farmland preservation and open space:

•Provide for the growth of the Township in such a way that its open rural character and natural beauty is preserved;
•Encourage the continuation of agricultural uses and allow for associated structures and operational considerations.
•Promote a land use pattern that is in harmony with the Township's environment;
•Ensure that natural resource protection is part of the planning process.
•Maintain a balanced Open Space Program
•Support the retention and viability of farm activities and forest resources.
•Preserve and enhance architecture and historic integrity in the Bending Brook Area.
•Consider development and submission of an application to the National Park Service for registration of Bending Brook area as an Agricultural and Industrial Historic District.

4.3.9 Frelinghuysen Township zoning

Frelinghuysen employs a traditional zoning schedule that sets allowable lot sizes, floor-area ratios, lot coverages, and acceptable uses. The Township has recently modified its zoning densities to reflect the agricultural, centers based landscape it wishes to resemble in the future. Zoning in and around the Township's villages (VN-1 and VN-2) have been changed to accommodate denser development patterns and more potential uses while zoning outside these centers has been changed to reflect lower density development patterns, such as the 3 and 6-acre Agricultural Residential (AR) zones. These low density "agriculture" zones occupy the majority of Frelinghuysen Township. Figure 4.19 and figure 4.20 are connected to each other and show this spatial organization of the urban elements. This land use planning according to density prepares the ground for an optimal use of land; i.e. when the qualifications of the land give permission to urban developments, the required densities would be implemented and low density patterns will be allocated to the agricultural lands with higher values which automatically is a form of preservation.

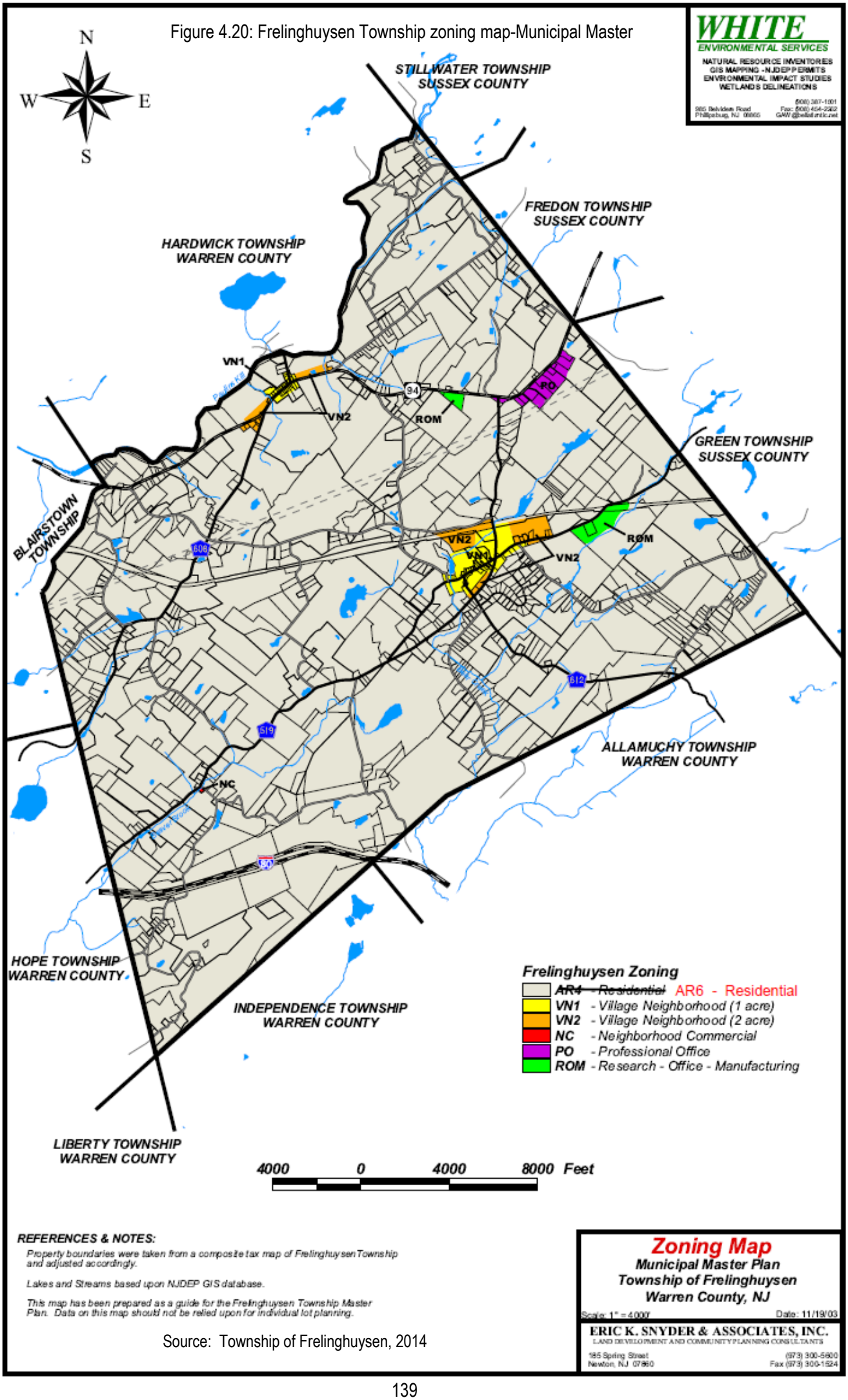
Figure 4.19: Frelinghuysen zoning density in zoning map (Figure 4.20)

Frelinghuysen Township Zoning Density				
Source: Warren County Planning Department				
ABBR	**ZONE DESCRIPTION**	**DENSITY**	**PRIMARY USE**	**ACRES**
AR-3	Agricultural Residential 3 Acre Lot	3 acres	Residential	6,578
AR-6	Agricultural Residential 6 Acre Lot	6 acres	Residential	8,264
NC	Neighborhood Commercial 1 Acre	1 acre	Commercial	2
PO	Professional Office 2 Acre	2 acres	Commercial	72
ROM	Research-Office-Manufacturing 3 Acre Lot	3 acres	Commercial	62
VN-1	Village Neighborhood 1 Acre	1 acre	Residential	148
VN-2	Village Neighborhood 2 Acre	2 acres	Residential	151
			TOTAL	*15,276*

Source: Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

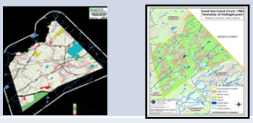
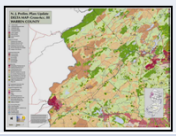
A summary of all the urban plans, their qualifications, objectives, produced maps and the body management responsible for them is shown in Figure 4.21. This table gives an overview of the sections explained above.

Figure 4.20: Frelinghuysen Township zoning map-Municipal Master



Source: Township of Frelinghuysen, 2014

Figure 4.21: Urban plans supporting preservation plan in Frelinghuysen

Urban Plan Name	Management body(s)	Objectives	Map	Conclusions/Out comes
Land use Plan	NJDEP Land use/Land Cover 1986-2002	Defining current and future use of the land		-Forested areas to farmland -farmlands to developed or barren
State Development and Redevelopment Plan (SDRP)	New Jersey State Planning Commission	General policy concerning future development		-Five Planning areas for planning activities -Designated development centers
Highlands Regional Master Plan	New Jersey State Legislature	Ensure the integrity of drinking water		-Highland preservation zone: strict -Mandatory buffers around water bodies
Agricultural Priority Zones	The Highlands Council	Farmlands priority		-according to soil quality, tillable acreage -High, medium and low priority
Frelinghuysen Township Master Plan	Township of Frelinghuysen	Land use pattern regulation		-preserve natural beauty -land use pattern-Environment -Retention farm activities
Frelinghuysen Township Zoning	Township of Frelinghuysen	Traditional zoning schedule		-Low density zones allocated to agricultural lands

Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

This figure shows how consistent different plans can be with each other although they are based on different backgrounds. When the land use plan proved that they have been a considerable amount of forests converted to farmlands and farmlands converted to barren lands during the time, this alarm was the start of producing the rest of the maps and the begin of the research on this area. Consequently in the first stage SDRP tried to define centers and areas for urban development to give direction to built-up areas and automatically preserve the farmlands/forest. Simultaneously Highlands Regional Master Plan which had the integrity of drinking water as one of its responsibilities designed buffers around water bodies to keep them far from urban developments. In this way the green lands around rivers were preserved as well. When these steps were taken as the first initial ones, the second phase of plans were launched which required the green lands to be first preserved. In this phase of the preservation the quality becomes important as the preservation of the certain quantity of land has been guaranteed by the previous phase. Therefore the lands are categorized according to their soil quality in agricultural priority zone map and it is tried to invest on the tillable farmlands first. Working on landscape and natural beauty is planned after it is certain that the endangered farmlands are preserved. At the end, the plan for directing the future developments on the right lands according to the outcomes of the above plans is produced which supports urban developments on the land with lower quality and does not let high densities on agricultural areas.

This chain of plans reflects a network of preservation in Frelinghuysen in which each element is based on the outcome of the other and they all follow one approach in different ways. To be able to produce a right and exact map for future urban, there should be a deep multidimensional study previously done by specialized organizations so that all different aspects of the city participate in the system and support the green lands preservation in their own territory.

4.3.10 Preservation planning tools

In addition to strategically locating development of high and low density, there are a number of other planning techniques the Township could employ to further its farmland preservation goals. The Township is currently considering many of these options.

Cluster zoning allows development to occur on a smaller percentage of a site while retaining the net development density permitted by local zoning. A common cluster zoning provision would allow (or require) 50% of a site to be preserved in its natural or agricultural state and would permit the other half of the site to be developed at twice the allowable zoning density. Some clustering ordinances require that certain sensitive natural areas or prime farmlands on a development site be preserved.

Lot size averaging is another planning tool that maintains the net allowable zoning density on a site, but does not enforce uniform lot size requirements or setbacks. This allows for some development lots to be very small in order to accommodate affordable housing units, neighborhood commercial stores, or "village" development densities while other lots can be very large in order to encompass active farms or natural areas.

Transfer of development rights (TDR) is a growth management tool that allocates development rights from one location (the preservation or "sending" area), to another (the development or "receiving" area). These development rights are purchased by builders, which mean that the private market provides landowner compensation and the use of public funds is unnecessary. So far, this technique had been employed only at the local level in New Jersey, but passage of the Highlands Water Protection and Planning Act will encourage its use on a regional level as well. Frelinghuysen Township is designated by the Highlands Act as part of the Planning Area, and may be eligible for inclusion as either a sending or receiving area. The transfer of development rights is a growth management tools that transfers development rights from one location, a preservation area, to another, an identified growth area. The development rights, purchased by the developer, are used to allow for development at a higher density than what the previous zoning of the receiving are allowed. To date, this program has not been used by Frelinghuysen to preserve farmland.

4.3.11 Economic incentives

There are different plans/ programs which have the content of economic incentives to give more motivation for farmland preservation such as County Easement Purchase, County Planning Incentive Grants, SADC Fee Simple, Municipal Planning Incentive Grants, SADC Direct Easement Purchase, and Nonprofit Grant Program.

County Easement Purchases involve the sale of farmland development rights to the county by the landowner. By selling their development rights to the county, the landowner agrees to restrict their land to agricultural use. The landowner still retains ownership of his or her farm and can sell it on the open market at any time, but the land is deed-restricted, in perpetuity, for agricultural use. To be eligible for the County Easement Purchase program, the land must be in an Agricultural Development Area, and be eligible for farmland assessment. A landowner must complete an application, which is reviewed by the CADB and then approved applications are forwarded to the SADC. In the past, these applications were distributed once a year. With the new County Planning Incentive Grant program there will no longer be an annual application date for the County Easement Purchase program.

Following review of the application, a site visit by the CADB and two independent appraisals must be conducted. Each appraisal should determine the land's fair market value and its agricultural value. The difference between these two is the price of the farm's "development rights," also known as the easement value. This is the price that the State offers to the landowner, and if this price is accepted, the County has title work and a survey done for farms receiving final State, County and Municipal approvals, and then schedules a closing. The landowner still retains ownership of his or her farm and can sell it on the open market at any time, but the land is deed-restricted, in perpetuity, for agricultural use. In Frelinghuysen, 13 farms have been preserved through the County Easement purchase program, protecting 1,274 acres of farmland.

County Planning Incentive Grants or PIGs is the second incentive program. Its goal is to protect and preserve large pieces of contiguous farmland through the purchase of development easements. The State Agriculture

Development Committee (SADC) has recently updated their rules (N.J.A.C. 2:76-6.3 through 2:76-17A.17) to promote County PIGs to streamline and expand the farmland preservation program throughout the state. Applications are now accepted year round. In order to qualify for PIGs, an agricultural advisory committee, as which the County Agriculture Development Board (CADB) functions for the county, is necessary. Additionally, the county must maintain a dedicated source of funding or alternative means for funding farmland preservation. Both county and municipal applications should correlate with county comprehensive farmland preservation plans. Warren County has developed their 2007 Comprehensive Farmland Preservation Plan in order to bring it in to compliance with the newly adopted guidelines and qualify for the County Planning Incentive Grant program.

Municipal Planning Incentive Grants (PIGs) as the third category are very similar to the County PIGs in their goals, requirements, and implementation. Like the County PIGs, Municipal PIGs require a local financial commitment for preserving farmland. Upon the completion of a municipal Farmland Preservation Plan and application to the SADC, grants are provided by the SADC in order to purchase development easements. The Farmland Preservation Plan Element describes the farms that are the focus of the municipal PIG. In order to qualify for this program, the town must have an agricultural advisory board and a source of funding for farmland preservation. Farms to be preserved through a municipal PIG need to be approved by the CADB. Warren County requires matching funding (50:50) between the County and the municipality, as part of a municipal PIG.

Frelinghuysen Township is currently enrolled in the Municipal Planning Incentive Grant program. The Municipal PIG for Frelinghuysen Township divides the Township into seven project areas. These Project Areas include the Allamuchy Farmland Belt, Limestone Valley-Bear Brook, Limestone Valley-Trout Brook, Martinsburg Ridge , Paulins Kill Valley, Johnsonburg District, and Hope Preservation Area. These Project Areas contain all of the preserved farms and one farm, located in the Limestone Valley Trout Brook Project Area, which is enrolled in the eight-year preservation program. Frelinghuysen Township successfully applied for funding through the municipal PIG program from the SADC in December 2005. In early spring of 2006 the Township was notified that it had been awarded $1,000,000 from the SADC towards its farmland PIG program. The Warren CADB passed a resolution in support of the Township PIG prior to its submittal in 2005. The Township anticipates utilizing $315,500 or approximately31% of their total SADC funding in this, their first year in the program, to purchase two farmland properties in 2008.

Also important to Frelinghuysen farmers is the State Agriculture Development Committee (SADC). The SADC is the lead program in administering the state's Farmland Preservation Program. The SADC provides cost share funding for the purchase of development easements; directly purchases farms and development easements from landowners; administers grants to landowners in the Farmland Preservation Program to fund up to 50 % of soil and water conservation projects; administers the Right to Farm Program; administers the Transfer of Development Rights Bank and operates the Farm Link Program which helps connect farm owners with potential tenant farmers.

The SADC Direct Easement Purchase is a program that allows a landowner to apply directly to the SADC for the sale of development rights. In most cases, the State will pay up to 100% of the certified appraised easement value in the direct easement purchase program. By participating in this program, the landowner still retains ownership of their land, but agrees to restrict land use to agricultural purposes. The Direct Easement Program does not receive monetary contributions from the County.

The other system which works as incentive program is SADC Fee Simple. A fee simple acquisition involves an entire property being purchased directly by the state. The SADC pays the survey and title costs, the landowner is exempt from paying roll back taxes for farmland assessment and the transaction can be completed in a matter of months. The SADC negotiates a purchase price subject to recommendations of two independent appraisers and review by a state review appraiser. The land becomes restricted so that it becomes permanently preserved for agriculture. In this type of acquisition, the landowner does not retain any rights. The property is then resold at auction; the SADC does not retain ownership. To qualify to participate in this program, the farmland must be within an ADA and be eligible for Farmland Assessment. No farms in Frelinghuysen have been preserved through a SADC fee simple acquisition.

The last economic incentive program is Nonprofit Grant Program. Grants are provided to nonprofit organizations by the State Agriculture Development Committee. These grants fund up to 50% of the fee simple or development easement values on farms. (SADC website) These grants help to preserve farmland throughout the county and generally the transactions involve properties with both agricultural and environmental significance. These grants are obtained through an application process, in which the land is evaluated by independent appraisers. As part of the nonprofit grant program with the SADC, Morris Land Conservancy successfully applied for nonprofit farmland funding from the State Agriculture Development Committee (SADC) for the preservation of three farms in Frelinghuysen in2007. If the projects are successful, all land costs will be provided by Morris Land Conservancy's SADC grant and the Warren County Agriculture Development Board (CADB). Frelinghuysen Township has agreed to cover all due diligence expenses on these projects. Three projects were part of this nonprofit application.

4.3.12 Spatial-special programs

This category comprises the time-based programs/ projects implemented by CADB, SADC and municipality as the three significant organizations involved in preservation. Warren County Agricultural Development Area, SADC Strategic Targeting Project and Eight Year Programs are in this category.

The Warren County Agriculture Development Board (CADB) developed the Warren County Agricultural Development Area (ADA) based upon both statutory and county criteria. The ADA designates land that has the potential for long-term agricultural viability. This agricultural use would be the preferred, but not the exclusive, use. Statutory Criteria are:

•The land must be agriculturally productive or have future production potential. Also, zoning for the land must permit agriculture or permit it as a non conforming use.
•Suburban and/or commercial development must be reasonably non-existent in the proposed ADA area.
•The land must comprise of no greater than 90% of the agricultural land mass of the County.
•Any attributes deemed appropriate by the Board must also be incorporated. Prior to this year, the entire County had been designated as being part of the Agricultural Development Area (ADA) with the exceptions of Hackettstown, Belvidere, Philipsburg, and Washington Borough. As part of the 2007 *Warren County Comprehensive Farmland Preservation Plan,* the Warren CADB has updated their ADA designating land capable of supporting agricultural and excluding those lands that are protected as public open space, developed areas, and land contained with the developed Boroughs and Towns located within the County. Utilizing the state's regulatory criteria for designating ADA and existing farmland assessment data, the County designated an ADA on a county-wide basis that does not exceed 90% of the County's agricultural land base. Whereas county criteria are:

•Land is currently in agricultural production or has strong potential for agricultural production or is farm assessed through a woodland management plan.
•Agriculture is the preferred, but not necessarily the exclusive use.
Overall, there are 10,275 acres of farm assessed parcels in Frelinghuysen. Of this, 9,150 acres (89%) of farm assessed land in Frelinghuysen is included within the Warren County proposed ADA.

The second spatial-special project is the SADC Strategic Targeting Project which is to prioritize farmland to be preserved by targeting farms for preservation based on specific criteria, including the prioritization of prime and statewide soils in agricultural production outside sewer service areas. According to the SADC, the Strategic Targeting Project has three primary goals. These are as follows: The coordination of farmland preservation and retention of agricultural practices "with proactive planning initiatives; to update and create maps which serve as a tool for more accurate preservation targets and to coordinate different preservation efforts, such as open space, with farmland preservation.

Through the use of the Strategic Targeting Program, the SADC hopes to more efficiently target and designate farmland for preservation and, by doing so, boost the State's agricultural industry. Frelinghuysen Township,

through the completion of its 2005 and 2008 Comprehensive Farmland Preservation Plans, meets each of the goals as outlined in the Strategic Targeting Project. As a participant in the Municipal Planning Incentive Grant program, Frelinghuysen Township's Farmland Preservation Committee will coordinate directly with the Warren CADB to identify and target farms for preservation in the Township.

The last program the Spatial-Special group is the Eight Year Programs in which the 8-Year Farmland Preservation Program and the Municipally Approved 8-Year Farmland Preservation Program are both cost sharing programs for soil and water conservation projects, in which the farmer receives 50% cost sharing for these projects as well as protection against nuisance complaints, emergency fuel and water rationing, zoning changes and eminent domain actions. In return, the farmer signs an agreement that restricts the land to agricultural use for eight years. For entrance into these programs and to qualify for benefits, a farm must be located within an ADA. Technical assistance for the soil and water practices comes through the Natural Resource Conservation Service. In Frelinghuysen, one farm is currently enrolled in through the eight-year program.

4.3.13 SADC and preservation costs

In 1983, the New Jersey State Legislature adopted the State Agriculture Retention and Development Act and created the State Agriculture Development Committee (SADC), which provides funding for farmland preservation programs, establishes farmland preservation policy statewide, and oversees program administration. Ten years later, in1993, a non-binding referendum was placed on the Warren County election ballot to provide dedicated revenue for land acquisitions. Warren County voters approved the referendum to create an Open Space and Farmland Preservation Trust by a 2 to 1 ratio, allowing $.02 per $100 of Total County equalized real property valuation to be collected. Of the 150 permanently preserved farms in Warren County, sixteen are located in Frelinghuysen. These 16 farms permanently protect 1,433 acres. With an average cost of $3,089 per acre, the State of New Jersey has spent $2,472,083, or approximately 56% of the cost share, to protect farmland in Frelinghuysen. The County has spent a total of $1,954,062 to protect farmland in Frelinghuysen, approximately 44%of the total cost share.

As shown in table 4.2 the majority of projects (89% of the total preserved farmland) are protected through the County Easement Purchase program. The SADC Direct Easement Purchase program supported the remaining projects in Frelinghuysen. There are currently five farms pending preservation in Frelinghuysen Township through two different preservation programs. Two farms have applied to the Township through the municipal PIG program and are scheduled to close in 2008. Three farms are part of Morris Land Conservancy's nonprofit PIG program. If all five projects are successful, Frelinghuysen would add an additional 281 acres of preserved farmland in the Township.

Table 4.2: Preserved farms in Frelinghuysen Township

Farm	Program	Year	Acres	Total Cost	State Cost	County Cost	Cost per Acre
Genesis Farm	County EP	1998	139	$318,916	$237,107	$81,809	$2,300
Moore, Chan	County EP	1998	72	$186,009	$137,361	$48,649	$2,600
Bennett, Thomas	County EP	2000	90	$269,292	$197,481	$71,811	$3,000
Young, Joseph	County EP	2000	65	$225,852	$161,323	$64,529	$3,500
Parrott / Simonetti	County EP	2001	117	$203,465	$153,729	$49,736	$1,739
Smolha, Jean	County EP	2001	79	$236,145	$0	$236,145	$3,000
Smolha / Feldman	County EP	2001	103	$289,069	$212,672	$76,397	$2,800
Smolha / Lolas	County EP	2001	51	$162,963	$118,148	$44,815	$3,200
Silverside	SADC Direct	2003	49	$161,799	$161,799	$0	$3,300
Staufenberger	County EP	2003	125	$463,233	$328,019	$135,214	$3,700
Gurba, Stephen #1	County EP	2003	179	$679,790	$0	$679,790	$3,800
Westbrook, Jacob*	County EP	2004	8*				
Gurba, Stephen #2	County EP	2004	88	$299,115	$0	$299,115	$3,400
Gurba, Stephen #3	County EP	2005	123	$345,794	$254,400	$91,394	$2,800
Van Grouw, William	SADC Direct	2005	102	$356,318	$356,318	$0	$3,500
Peck	County EP	2006	44	$228,386	$153,726	$74,659	$5,200
Total			***1,433***	***$4,426,145***	***$2,472,083***	***$1,954,062***	***$3,089***

Source: Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

In figure 4.23 the most effective and important programs, plans, projects and tools to preserve farmlands in Frelinghuysen have been categorized according to their goals, function, level of function, procedure and the urban authority responsible for the plan. This table attempts to give a clear overview of the above sections. As explained above there are three main categories of plans/ programs in Frelinghuysen so far. The first one is Preservation planning tools whereas the second one is incentives and at last spatial-special program.

4.3.14 Funding/supportive tools

Explaining the preservation costs highlights the necessity of more financial resources to support preservation, therefore there is also another group of tools which is not presented in figure 4.23 as they all have a supportive role and provide the necessary finance for the mentioned plans/ programs. They cannot be considered as plans individually but they are tools and means to complete and implement the preservation plans. This group has three main categories as Funding plans, Warren County Trust Fund and economic development programs are the three main groups.

Funding plans comprise Donation and Installment purchase which both serve to leverage limited funding resources. Donation and Bargain Sale is a mechanism for preserving a farm involves a donation by the landowner. If the landowner donates a portion of the value of the development rights when an easement is sold, this is called a bargain sale. A bargain sale can result in substantial tax savings for the landowner and can stretch farmland preservation funds. The landowner donation is a reduction in the amount of gain that is subject to the capital gains tax, and the landowner can take a tax deduction for the amount donated against his or her federal and state income taxes.

Through an installment purchase agreement, development rights may be acquired by Frelinghuysen Township through a payment plan that provides payments to the landowner over time. Receiving the income from the sale in installments may provide the landowner with financial management and/or tax advantages.

The Warren County Open Space Recreation Farmland Preservation Trust Fund generates approximately $7.8 million annually. Of this, $4.5 million is available for farmland preservation in 2007. Frelinghuysen Township works with Warren County according to its current cost-share requirements for preserving farms. The County's policy is that Warren CADB will fund one-half of the difference between the amount the SADC funded and the total cost for preserving a farm, based upon the Certified Market Value, through the municipal Planning Incentive Grant program. The remainder is funded by the municipality.

Frelinghuysen benefits from the Economic Development Program provided by Warren County to help the county's agricultural community stay strong and vibrant. Livestock cooperative auction, farmer's market and community supported agriculture are the examples.

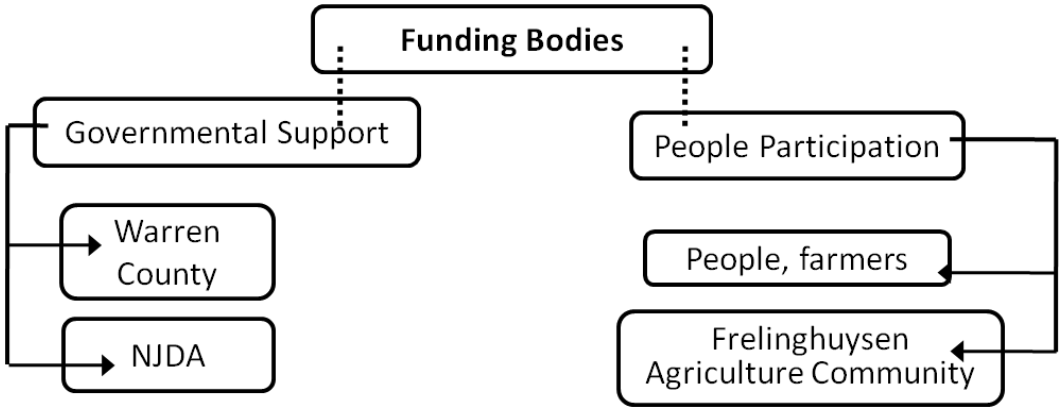
Livestock Cooperative Auction is a co-op run by the Auction Market Association of North Jersey, comprised mostly of farmers, and has been operating since 1941. Farmers, as well as restaurants and private individuals sell, buy, and trade livestock, eggs and crops. Farmer's Market in its tenth year, the Farmer's Market offers for sale various fruits, vegetables, homemade sausage, grains and other products grown or made by local farmers. Community Supported Agriculture means that the economic support of the Frelinghuysen agricultural community also comes from local grass roots groups. This support is embodied in Community Supported Agriculture which consists of:

- A community of individuals who pledge support to a farm operation so that the farmland becomes the community's farm.
- Members or "share-holders" of the farm pledge in advance to cover the anticipated costs of the farm operation and farmer's salary
- Members receive shares in the farm's products throughout the growing season
- Members also receive the satisfaction gained from reconnecting to the land and participating directly in food production
- Members also share in the risks of farming, including poor harvests due to unfavorable weather or pests

- Generally, growers receive better prices for their crops, gain some financial security, and are relieved of much of the burden of marketing
- Another local, grass roots group supporting community agriculture in Frelinghuysen is the Food shed Alliance. The Alliance promotes local efforts by assisting individual farmers with sustainable farming methods, connecting farmers with consumers through farmers markets and buyers clubs, and gathering information about how much land is being farmed in the Ridge and Valley region. In addition, they offer Farmers Forums every year at the Frelinghuysen School to educate farmers on the economic benefits of sustainable agriculture and locally grown food and its importance to healthy communities and nutritious living.
- Sustainable Agriculture Research and Education (SARE) is a "United States Department of Agriculture competitive grants program with regional programs and regional leadership. SARE supports research and education that helps build the future economic viability of agriculture in the United States.
- The Agricultural Marketing Resource Center (AgMRC) brings together agriculture experts from Iowa State University, Kansas State University and the University of California "…to create and present information about value-added agriculture. The center draws on the abilities, skills and knowledge of leading economists, business strategists and outreach specialists to provide reliability in value-added agriculture".

  Thus as shown in figure 4.22 the funding preservation bodies are not just limited to governmental organizations, although government has to invest considerably on this field but without people participation in supporting the plans, it is not able to last long. Moreover the people get motivation to support the plans when economic incentives exist, therefore this is a chain which should have all its elements to be successful. The debate about people participation will be discussed later.

Figure 4.22: Funding body structure in Frelinghuysen Preservation Plan



Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

Figure 4.23: Plans, programs and tools supporting farmland preservation in Frelinghuysen

Name of the Program /Tools	*Cluster Zoning (Planning Tool)*	*Lot Size Averaging*	*County Easement Purchase*	*County Planning Incentive Grants(PIG)*	*Municipal Planning Incentive Grants (PIG)*	*SADC Direct Easement Purchase*	*SADC Fee Simple*
Involved Authority	Township	Township	SADC/CADB	County, SADC,CADB	SADC	SADC	SADC
Target(s)	Limit development expansion	Suit the parcel size to the function(large to encompass farms, small for affordable housing)	Encourage farmers to keep their lands by retaining their ownership and obtaining easement value	Protect the large pieces of contiguous farm through purchase of development easement	Protect the large pieces of contiguous farm through purchase of development easement	Directly purchase farm and development easement from landowners	Preserve completely and directly by state
Type of Function	Technical, specialized urban planning	Technical, specialized in urban planning	Economic-incentive program	Economic-incentive program	Economic-incentive	Economic-incentiveprogram	Economic-incentiveprogram
Level of Function	Parcels	Parcels	Each farm of the county	County ,State	State	State	State
Procedure/ Process	-50% preserved -50% twice zoning density	-Maintains the net allowable zoning density -No enforce for uniform lot size	The difference between fair market value and agri-value is given to farmer -Application reviewed by CADB and approved by SADC	-For qualification: an agricultural advisory committee, CADB -development easement is purchased	-application to SADC -grants by SADC -Town Agricultural Advisory Board to qualify -approved by CADB -fund 50%by county -50% by municipality -divided Frelinghuysen in 7 project area	-Landowner applies directly to SADC for the sale of development rights -most cases 100% paid by State -Ownership remains for landowner	-Farm purchased directly by state -No rights are retained by landowner -Resold at auction -SADC doesn't retain ownership -For qualification :farmland in ADA

Figure 4.23: Plans, programs and tools supporting farmland preservation in Frelinghuysen (Continued)

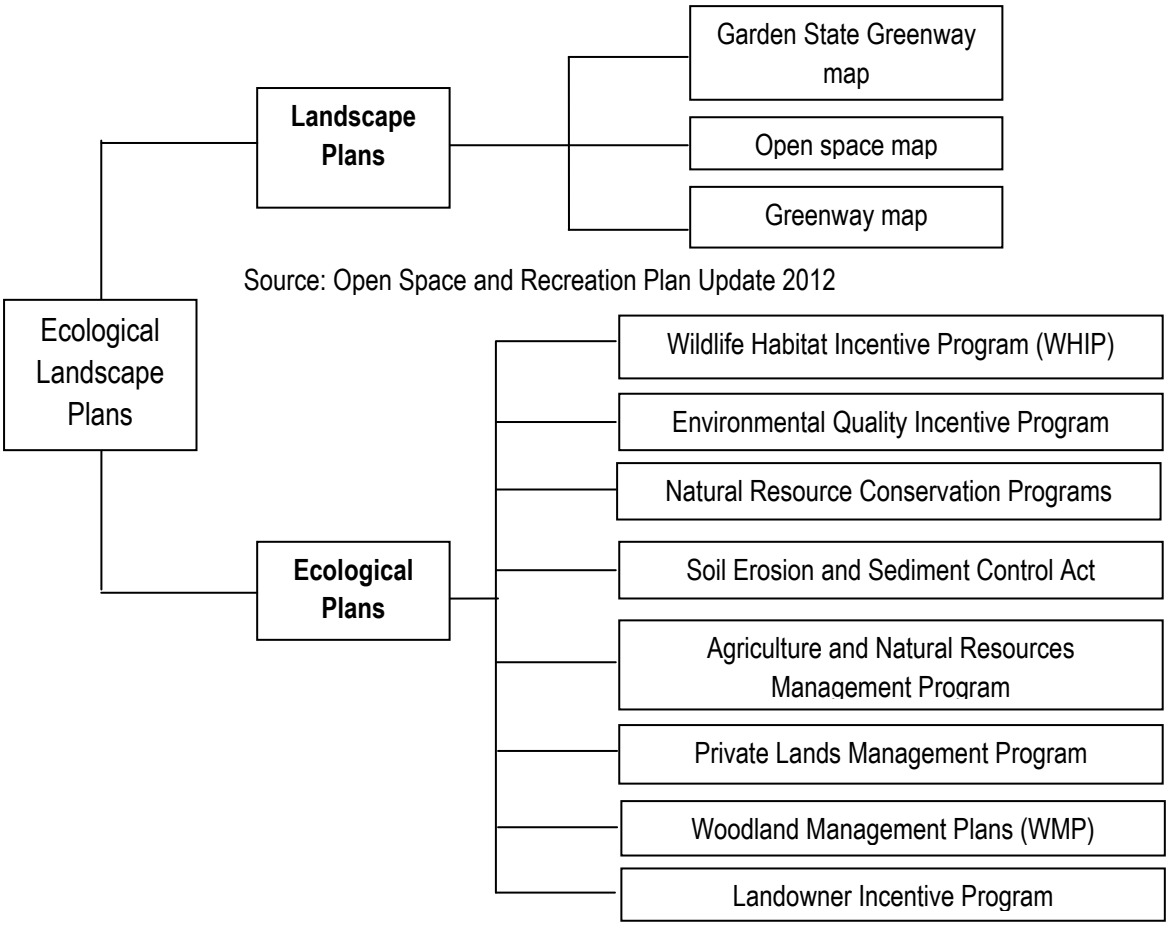
Name of the Program /Tool	*Warren County Agricultural Development Area (ADA)*	*SADC Strategic Targeting Project*	*Eight Year Program*	*United States Department of Agriculture Rural Development Program*	*Income Averaging for Farmers*	*USDA Farm Service Agricultural Program*
Involved Authority	CADB	SADC	Municipality, SADC	USDA	Us Department of Treasury's Internal Revenue Service	USDA ,Farm Service Agency(FSA)
Target(s)	Designates land for long term agricultural viability	Prioritize farmland to be preserved based on specific criteria	Voluntarily restrict nonagricultural development for 8 years in exchange of benefits	-Technical assistance to agricultural cooperatives -agricultural sustainability	Smooth out economic disparities that farmers experience	Guaranteed farm ownership and operating loans to farmers who cannot obtain credit from banks or other institutes
Type of Function	Programmatic zoning tool	Programmatic zoning tool	Incentive program	Economic	Economic	Economic
Level of Function	County	State	State	Federal	Federal	Federal
Procedure/Process	-two types of criteria :Statutory and county criteria -agriculture is preferred ,no exclusive		-farmer accepted to restrict the land to agricultural use -farmer receives 5-% cost sharing (soil and water conservation projects) -farmer receives protection against nuisance complaints, emergency fuel -qualify :ADA	3 key areas for Grants: -Rural Business Cooperative Service -Rural Housing Service -Rural Utilities Service Qualify: less than 10,000 residents in a municipality	-qualified farmers can average all or part of their current year farm income over the previous 3 years-substantial tax dollars can be saved by income averaging	The farmers should be beginners and family sized.

Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

4.3.15 Ecological-landscape plans

In the process of farmland preservation, there are different ecological, environmental and landscape plans which are thoroughly compatible with the context of preservation plans and use the opportunity to complete these plans in the direction of sustainability, ecology and urban natural beauty. The Ecological-Landscape plans can be divided into two main groups of landscape and ecological. The landscape plans try to find the harmony between the existing open green space and the preservation plans and includes three plans in Frelinghuysen (Figure 4.27). A cooperative project involves a partnership and/or funding from more than one agency. These "hybrid" projects are an opportunity to use traditional open space funds, where appropriate, to help preserve farm properties, especially where those properties are a mixture of cropland and woodland areas. Farmland preservation and the identification of targeted farms should be coordinated with open space planning efforts. In Frelinghuysen, the Farmland Preservation Committee currently works with the Open Space Committee to coordinate the Township's progress toward both farmland and open space preservation. These committees are guided by this Comprehensive Farmland Preservation Plan as well as the Township's 2006 Open Space and Recreation Plan. The Open Space and Greenways Maps (Figure 4.25 and 4.26) from the 2012 Open Space and Recreation Plan are included below and identify priority areas for open space preservation and potential locations for trails in the Township. Also below is the Garden State Greenways map (Figure 4.24) for Warren County and Frelinghuysen Township which details the location of local and regional open space and recreational lands in and around Frelinghuysen Township. These maps may be used in conjunction with the Township's Project Areas Map (Figure 4.31 shown in section 4.3.18) to identify and preserve land for open space and farmland protection. For more effective preservation in this plan farmland, open space and greenways has been recognized as one unique network which have interrelated elements and should be preserved as a whole. Therefore different organizations responsible for producing different maps and plans should cooperate with each other to have better outcome (Figure 4.28).

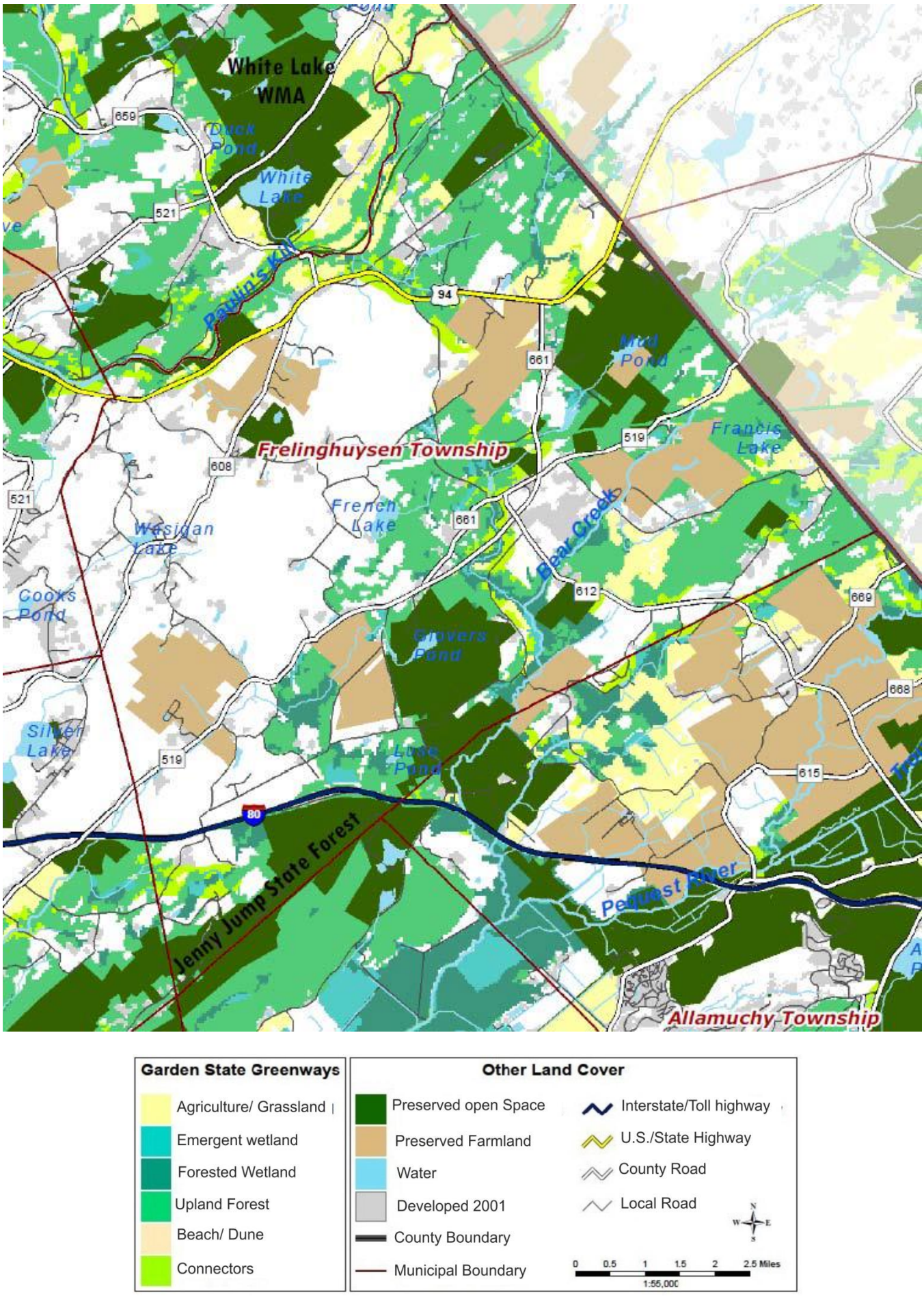
Figure 4.27: Different types of ecological landscape plans in farmland preservation in Frelinghuysen



Source: Open Space and Recreation Plan Update 2012

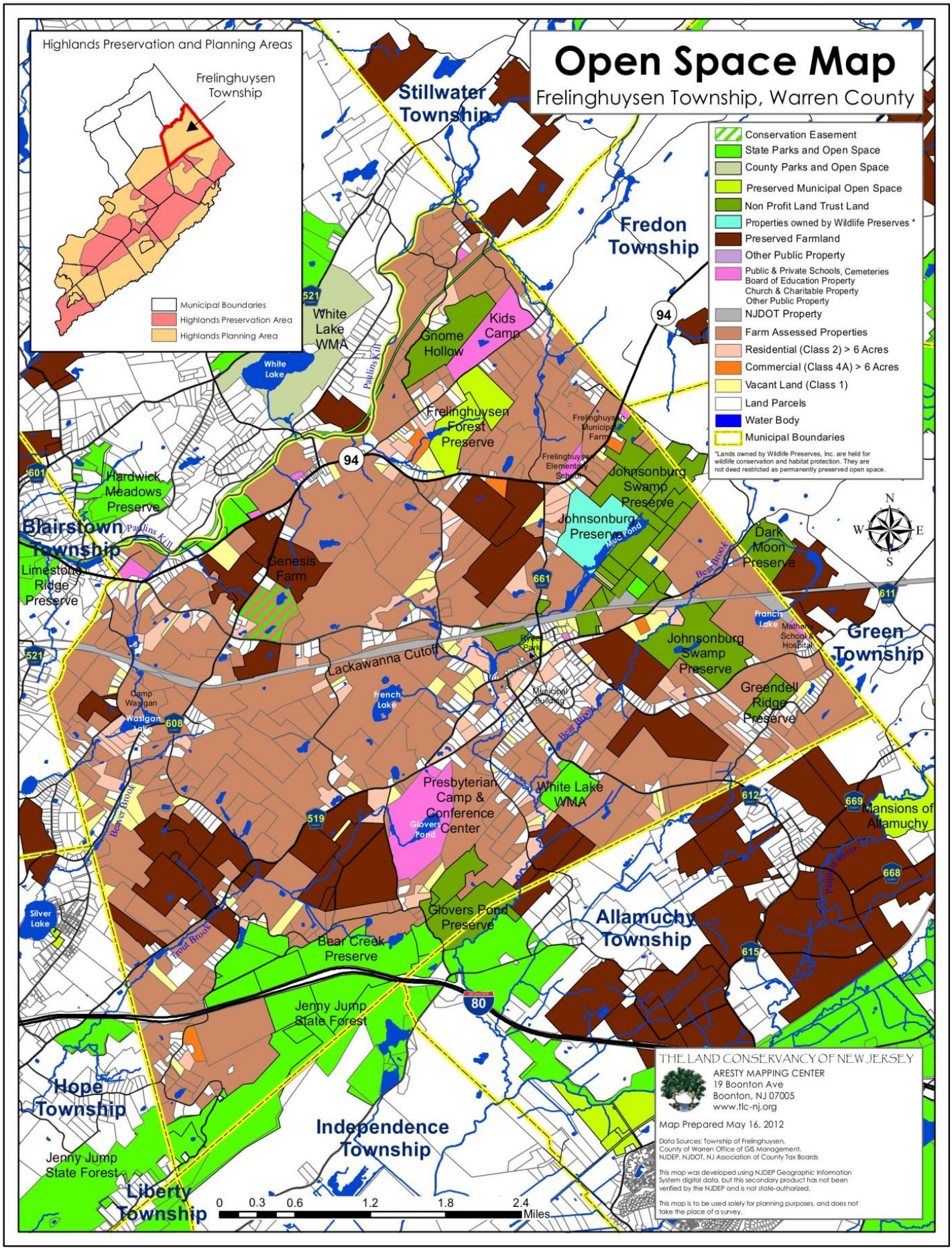
Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

Figure 4.24: Garden state Greenway map in Frelinghuysen



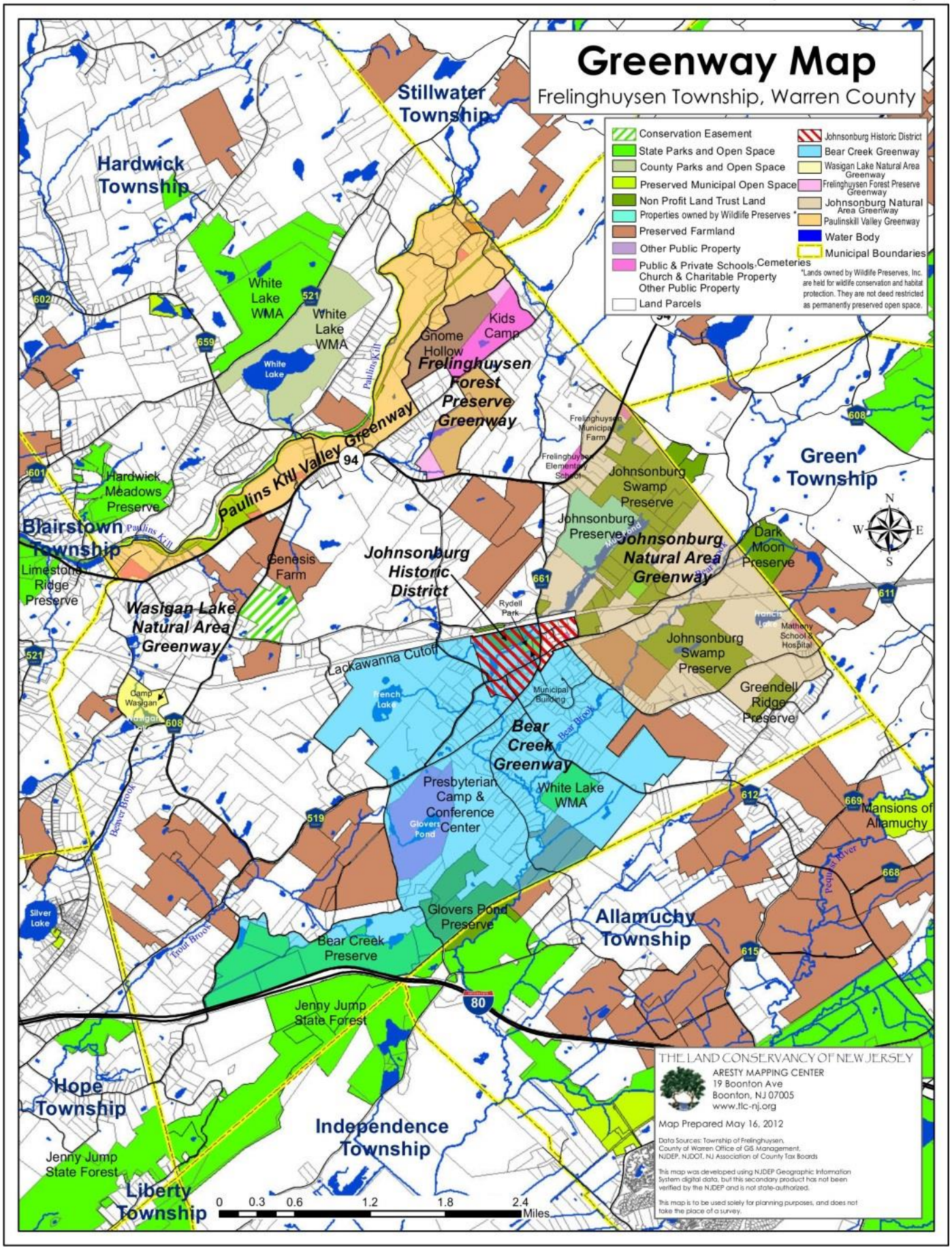
Source: Open Space and Recreation Plan Update 2012

Figure 4.25: Open Space Map in Frelinghuysen



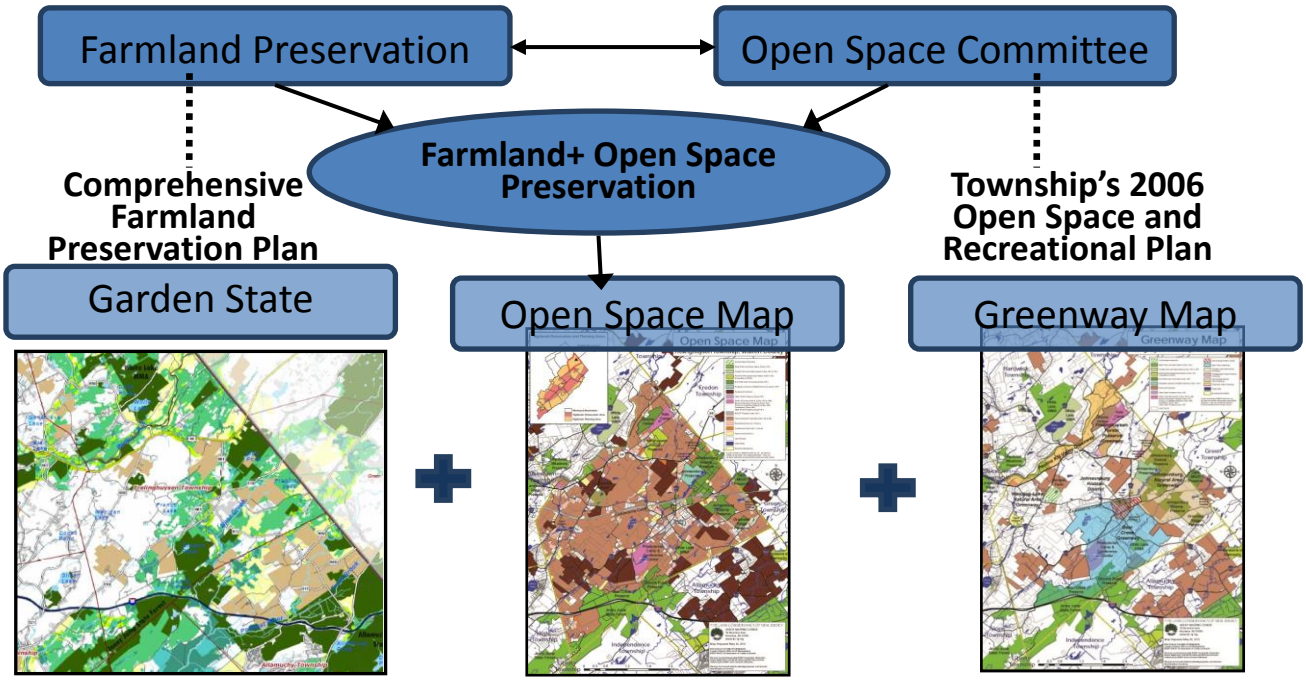
Source: Open Space and Recreation Plan Update 2012

Figure 4.26: Greenway Map in Frelinghuysen



Source: Open Space and Recreation Plan Update 2012

Figure 4.28: Combining farmland and open space preservation as green network preservation in Frelinghuysen



Source: After Open Space and Recreation Plan Update 2012

The second type of Ecological-Landscape plans which comprises couple of ecological plans/ supportive organizations is more focused on sustainable development and resources. There are numerous entities, both public and private, which administer, fund, and provide technical guidance for Frelinghuysen farmers relative to natural resource conservation:

An important partner in support of natural resource conservation for the agricultural community is the United States Department of Agriculture (USDA)'s Natural Resources Conservation Service (NRCS).The *NRCS* "provides assistance to private land owners (including farmers) in the conservation and management of their soil, water, and other natural resources." The NRCS provides technical assistance suited to the natural resource issues that are specific to a farmer's needs, with ample opportunity for cost shares and financial incentives. The local NRCS office helps to prepare Conservation Plans for farmers. These Conservation Plans nearly always include strategies to conserve soil and water, but may also include conservation practices for flora, fauna and clean air. If all five elements are included, they are referred to as Resource Management Plans.

Within one year of selling their development easement, owners of preserved farms are required to enter into a Conservation Plan. The Plans are also required to apply for natural resource conservation program grants such as the Wildlife Habitat Incentive Program (WHIP) and Environmental Quality Incentive Program (EQIP). The local NRCS office administers these conservation program grants, which offer financial incentives to support conservation projects.

Another partner in the conservation of agricultural resources is the New Jersey Department of Agriculture, Division of Agricultural and Natural Resources. Among its responsibilities, the Division implements the natural resource conservation programs, administered by the State Soil Conservation Committee (SSCC). These programs "provide engineering services and regulatory guidance to soil conservation districts, homeowners, engineers, planners, and virtually all development activities. The Division provides technical standards applicable to construction and mining sites regulated by the Soil Erosion and Sediment Control Act program.

The Rutgers Cooperative Extension (RCE) of Warren County provides both field and technical research focused on best management practices for farmers to ensure the long term viability of both the agricultural economy and the natural resources upon which it is based.

Relative to natural resource conservation, the *RCE of Warren County* offers the Agriculture and Natural Resource Management program. This education program provides "non-biased, research-based educational programs and services for both homeowners and commercial producers. Services offered by extension personnel include soil testing, insect identification, plant disease diagnosis, and pest management recommendations for agricultural operations", as well as "educational publications covering a wide range of agricultural topics.

The SSCC, NRCS, Warren County SCD, and RCE of Warren County, are part of the New Jersey Conservation Partnership. The New Jersey Department of Environmental Protection's (NJDEP), Division of Parks and Forestry, oversees the "Private Lands Management Program". The aim of this program is to foster wise stewardship and management of the state's 270,000 acres of private woodlands currently under farmland assessment. Some properties in Frelinghuysen that are farmland assessed include extensive woodland tracts. As of 2005, 2,215 acres in Frelinghuysen was in woodland management, accounting for 20% of the total assessed farmland. These tracts were added as "farm products" in the 1970's. These woodland tracts, which must be utilized by the farmer as a sustainable "product", require Woodland Management Plans (WMPs) to receive reduced local property taxes accorded properties in the farmland tax assessment program. The NJDEP's Division of Parks and Forestry, Bureau of Forest Management (BFM) reviews applications for WMPs, which are prepared for farmers by private consultants. Once a WMP is in place, a "Woodland Data Form" must be submitted yearly to certify that the WMP is being complied with. However, the NJDEP, BFM, also inspects each site once every three years to verify compliance with WMP conditions.

The New Jersey Department of Environmental Protection's Nongame and Endangered Species Program also administers the Landowner Incentive Program (LIP). LIP works to improve habitat, habitat management, and habitat protection for threatened and endangered species on private lands, some of which are agricultural lands. Project durations must be for a minimum of five years, and the property owner contributes a minimum 25% cost share. In Warren County, there are a total of 1,010 acres enrolled in LIP on 16 farms.

The United States Forest Service sponsors the Forest Stewardship Program. This program supports landowners whose property has a woodland management plan that recognizes and manages the wetlands, wildlife, aesthetics, soil, and water in addition to the woodlands on the property. This program, when fully funded, offers landowners cost share initiatives to allow the landowners to fully follow the guidelines in their woodland management plan. In New Jersey, the state farmland tax program and the U.S. Forest Service program have merged to allow one planning document for the landowner where the stewardship plan meets the state tax code and eliminates conflicts between the two.

Increasing enrollment of landowners in this merged state-federal program will ensure increased protection of the natural resources for an extended period. The minimum is a ten-year management plan. This does not ensure preservation of the land in perpetuity, but it does allow recognition of the importance of the land value and stewardship of the property for a longer period of time. In Frelinghuysen, there are 616 acres of farmland on 6 different properties enrolled in the Forest Stewardship program.

The North Jersey Resource Conservation and Development (RC&D) Council's main mission is to "facilitate the wise use and protection of the region's human and natural resources (which includes farmland). This is accomplished by working with communities and regional partnerships to address issues related to water quality and water resource protection, sustainable farming and farm communities, building local community capacity, and managing natural hazards that impact community planning". Each RC&D area usually consists of several counties, and has a council composed of local citizens who serve on a voluntary basis, as well as government representatives. Under the leadership of NRCS, the North Jersey RC&D Council receives technical assistance and may be able to qualify for financial assistance of up to 25% of needed funds, or a maximum of $50,000, from the U.S. Department of Agriculture.

Private non-profit groups and private citizens are playing a big role as well. Agriculture needs not only the broad support of state, county, and local governments to help preserve agriculture resources, but also the help of private nonprofit groups and citizens. Indeed, without their support, government programs and support for

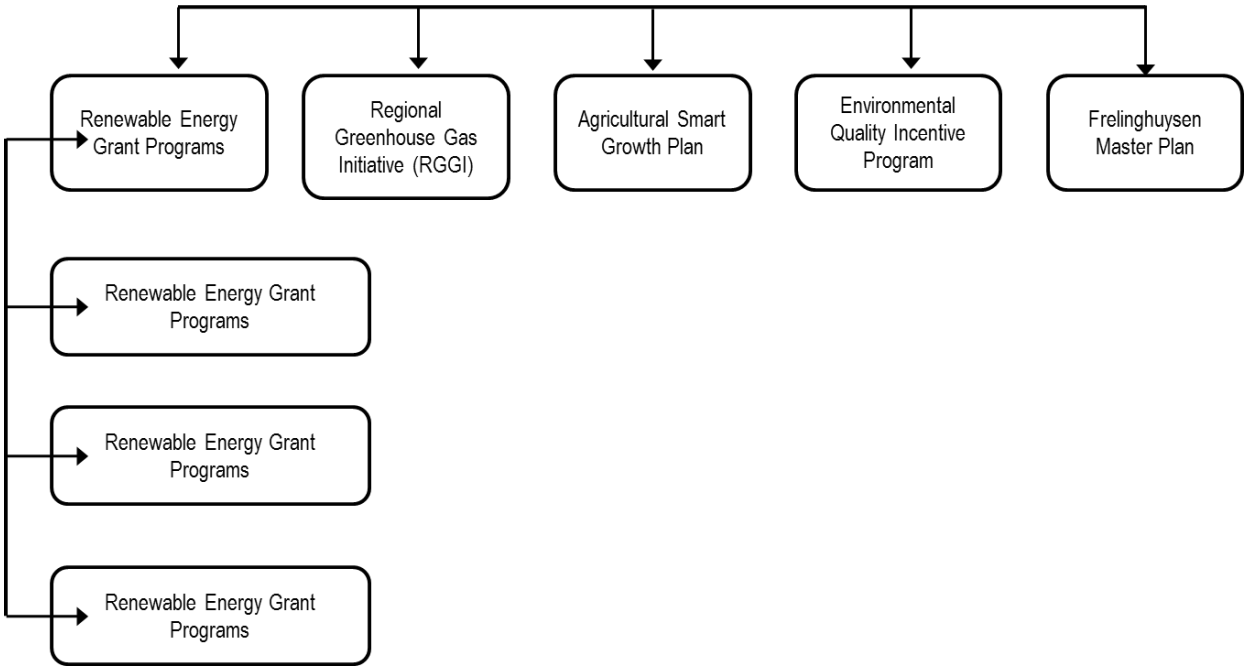
agriculture would fall short of what is needed to protect the natural resource base of the agricultural landscape. These groups and citizens spend countless hours providing and sharing their expertise, as well as raising and contributing money. They are invaluable in assisting with all phases of farmland preservation for Frelinghuysen, including natural resource conservation and stewardship.

The Frelinghuysen agriculture community has the support of a variety of organizations, including the Warren County Board of Agriculture, New Jersey Farm Bureau, 4-H, Future Farmers of America, and the Warren County Farmers Fair. Local and regional non-profit organizations also contribute to the permanent protection of farmland. These groups include Morris Land Conservancy, The Nature Conservancy, New Jersey Audubon Society, New Jersey Conservation Foundation, and the Ridge and Valley Conservancy. The Frelinghuysen agriculture community, via the Frelinghuysen Farmland Preservation Committee, can work with non-profit organizations and private citizens in a coordinated fashion to further the farmland preservation program in the Township. In Figure 4.29 the natural resource protection organizations and the programs they produce in farmland preservation in Frelinghuysen have been categorized.

4.3.16 Energy conservation plans

Besides Ecological Plans there are other plans which also focus on sustainability but in energy fields)Figure 4.29). Energy conservation makes economic sense for Frelinghuysen agriculture businesses. The less energy a farmer uses, the less money spent on energy, and the more money that can be invested elsewhere, or realized as profit. However, energy conservation and the use of alternate technologies also make environmental sense. They help keep the air, water and soil clean, and minimize or eliminate further pollution to these critical agricultural resources. Also, with the impending threat of global warming due to excessive carbon dioxide emissions into the atmosphere, energy conservation and the use of alternate energy sources can help to slow this warming trend. These plans are shown in figure 4.30.

Figure 4.29: energy conservation programs in farmland preservation plan in Frelinghuysen



Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

Figure 4.30: Ecological plans, bodies and Programs supporting farmland protection plan in Frelinghuysen

Authority, Preservation Management Body			**Related Program/Act/Policy**	
Natural Resources Conservation Service (NRCS)	United States Department of Agriculture (USDA)		Soil, water conservation assistance to farmers	
	Local Scale		Conservation plan	Wildlife Habitat Incentive Program (WHIP)
				Environmental Quality Incentive Program (EQIP)
NJ Department of Agriculture	Division of Agricultural and Natural Resources		-Natural Resource Conservation Programs -Soil Erosion and Sediment Control Act Program	
Rutgers Cooperative Extension of Warren County(RCE)			Agriculture and Natural Resources Management Program	
NJ Department of Environmental Protection (NJDEP)	Division of Parks and Forestry	Bureau of Forest management (BFM)	Private Lands Management Program	
			Woodland Management Plans (WMP)	
			NJDEP's nongame and Endangered species	
			Landowner Incentive Program	
United States Forest Service			Forest Stewardship Program	
North Jersey Resource Conservation and Development (RC &D) Council			Facilitate the wise use and protection of region's human and natural resources including farms	
Private and non-profit groups and private citizens	Warren County Board of Agriculture		Without their support and help, government programs for farmland would fall short. They spend countless hours providing and sharing their expertise, as well as raising and contributing money.	
	New Jersey Farm Bureau			
	4-Hfuture Farmers of America			
	Warren County Farmers Fair			
	Morris Land Conservancy			
	The Nature Conservancy			
	New Jersey Audubon Society			
	NJ Conservation Foundation			
	Ridge and Valley Conservancy			
New Jersey Conservation Partnership	SSCC,NRCS, Warren County SCD,RCE of Warren County		To union and concentrate on preservation	

Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

4.3.17 Scientific eligibility tools

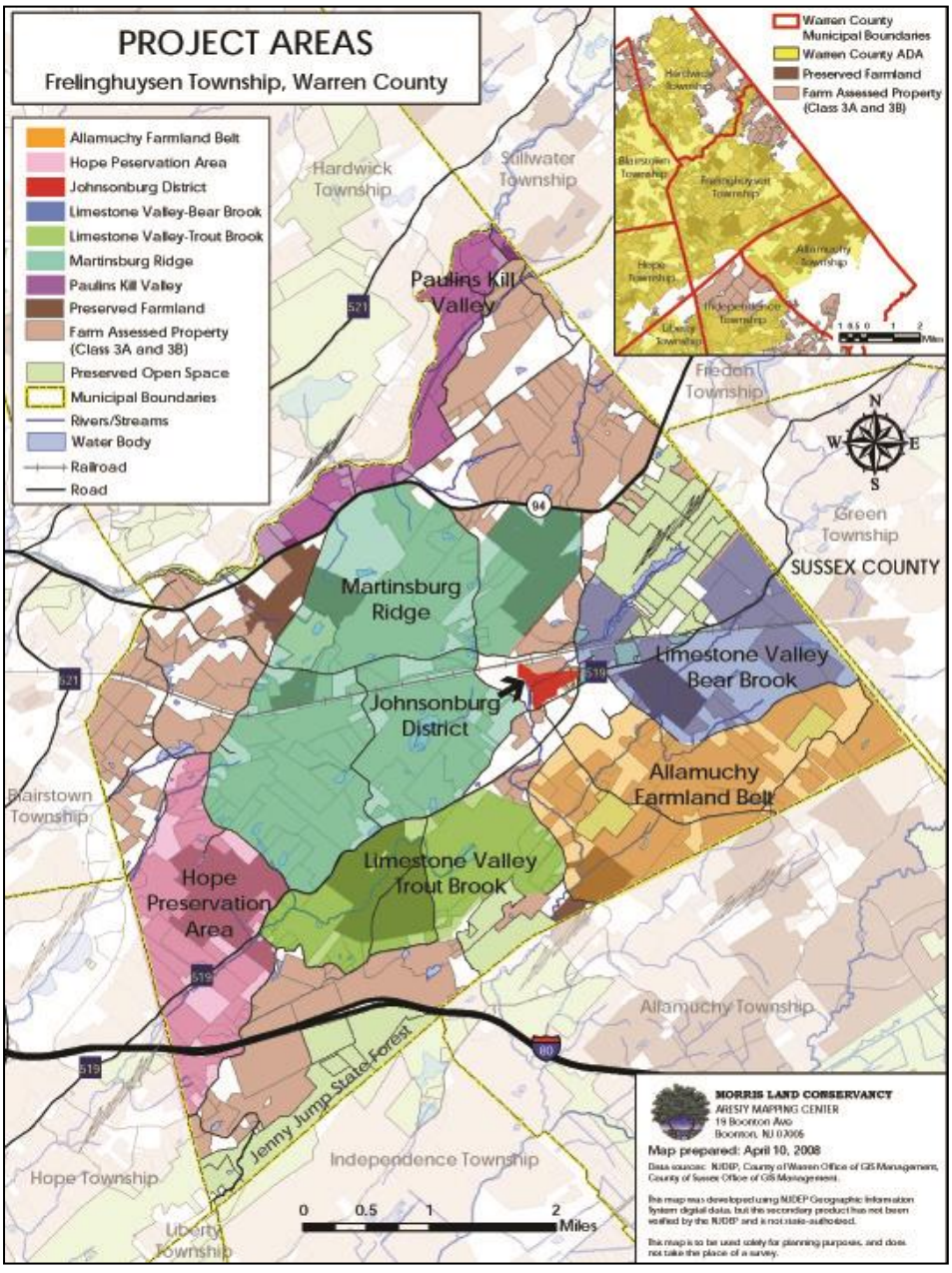
These kinds of tools are the scientific base for preservation system in Frelinghuysen which can be applied by Iran governance as well. There are three tools in this group; minimum eligibility tools, tillable land evaluation tool and county and municipal ranking criteria.

4.3.18 Minimum eligibility tools

The Frelinghuysen Township Farmland Preservation Committee has identified seven distinct project areas for farmland preservation. These project areas are shown on the *Project Areas Map* (Figure 4.31*)* included within this Plan and described below.

Allamuchy Farmland Belt
Hope Preservation Area
Johnsonburg District
Limestone Valley - Bear Brook
Limestone Valley – Trout Brook
Martinsburg Ridge
Paulins Kill Valley

Figure 4.31: Project Areas map in Frelinghuysen



Source: Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

For each project area, an analysis was completed to identify the amount and density of preserved farmland, soils and size of the area. The minimum eligibility analysis involved a parcel-based screening of tax lot characteristics. Farmland preservation applications often include multiple lots; combining these lots may increase the acreage eligible for SADC cost share funding in Frelinghuysen Township. For each project area the following was determined:

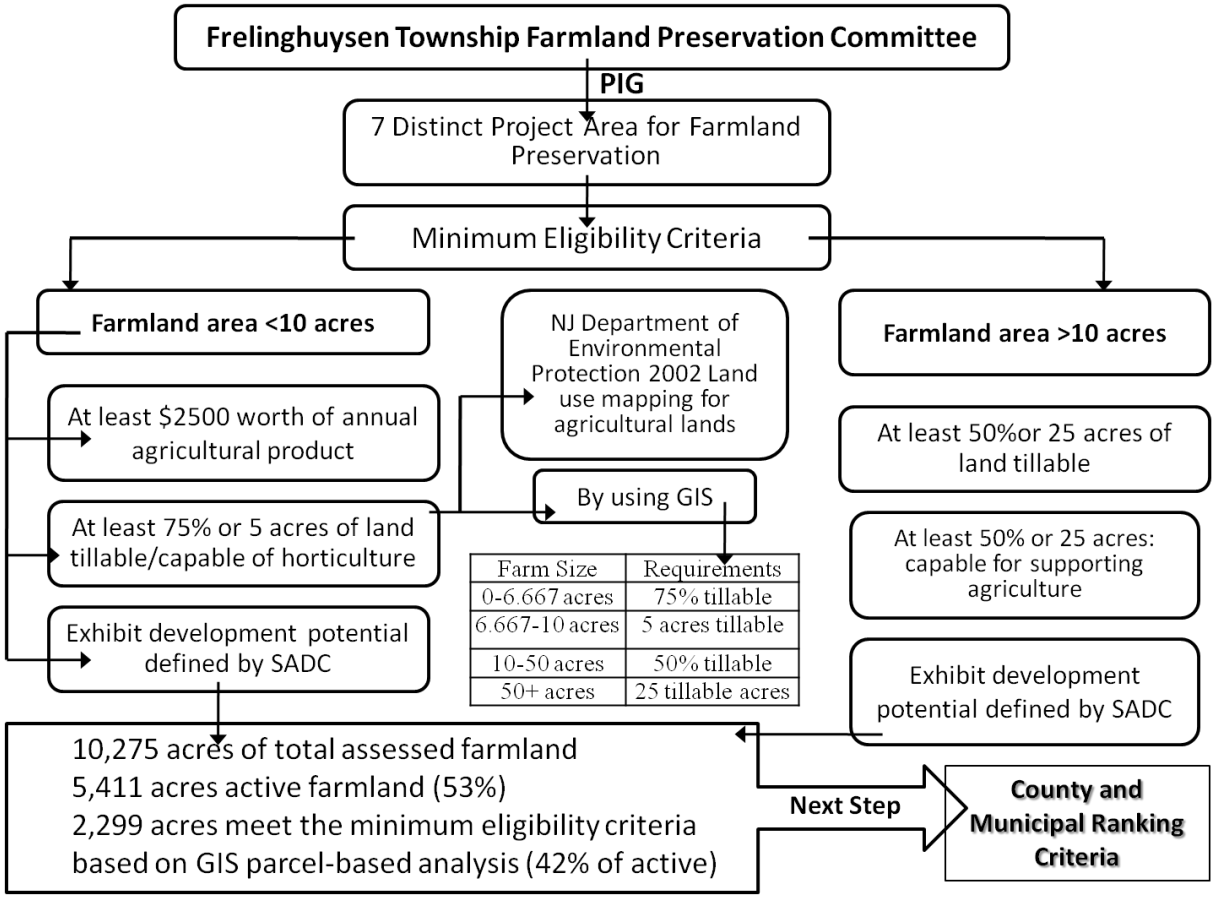
•The size of the total project area (in acres);

•The total acreage of preserved farmland in the project area;

•The acreage of publicly held open space in each project area;

•The total acreage of prime soils, soils of statewide importance, and unique agricultural soils in each project area. For each of the above categories, the land area within each project area is expressed as a ratio between the total acreage for each category and the total acreage of the project area. Also included is the percentage of each category expressed as a percentage of the total project area. Figure 4.32 shows how the Frelinghuysen Township Preservation Committee implements the minimum eligibility tool to filter and categorize the farmlands.

Figure 4.32: Minimum Eligibility Criteria Procedure conducted by SADC to select the eligible sites for preservation



Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

4.3.19 Tillable land evaluation tool

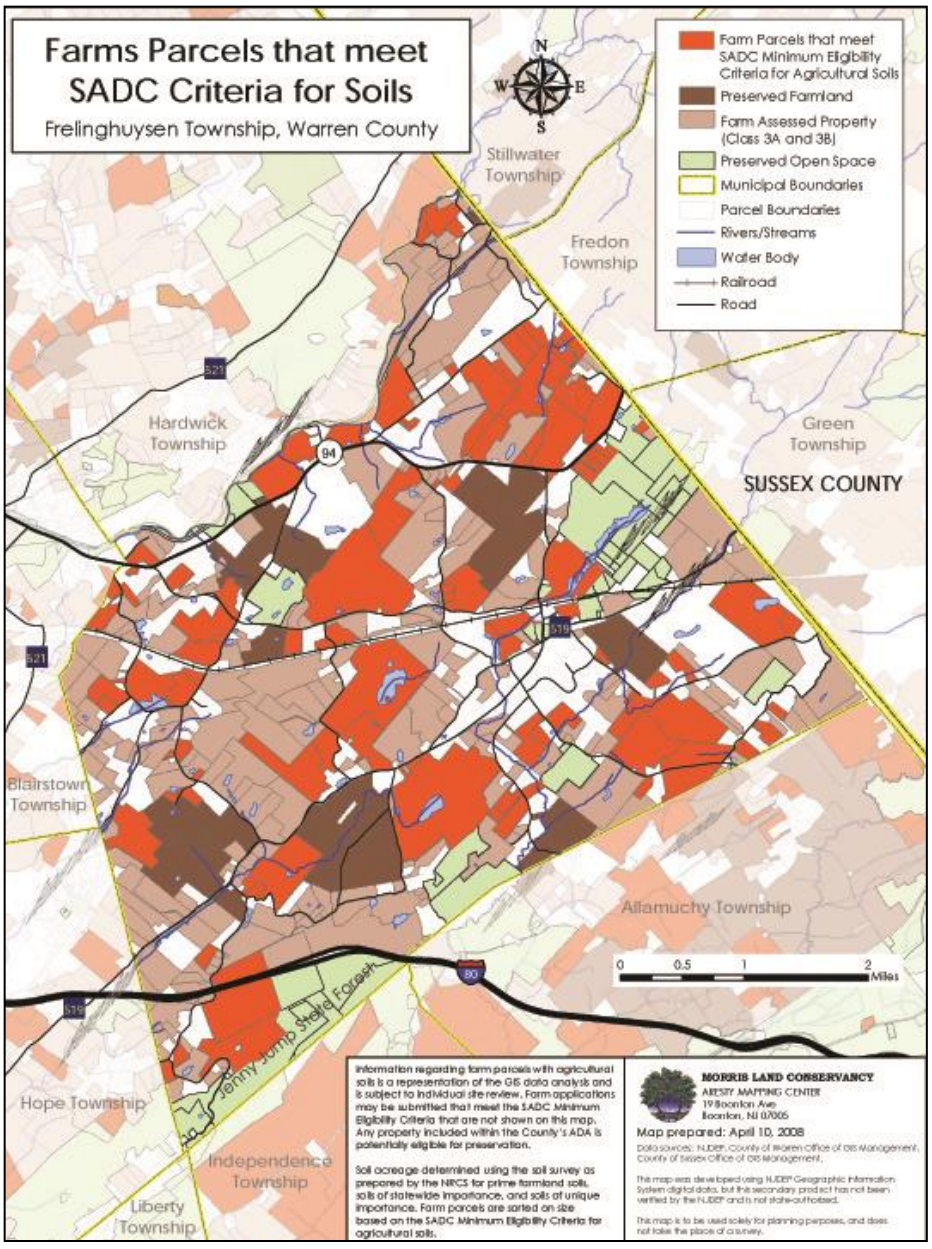
In order to evaluate the land in Frelinghuysen, the following queries were made utilizing the Arc GIS 9.2 digital mapping software: *Farmland that meets the SADC criteria for agricultural soils (Figure 4.33 and 4.34)*

Figure 4.33: Soil requirements and classification by SADC

Farm Size	Requirements
0-6.667 Acres	75% soils capable of supporting agricultural production
6.667-10 Acres	5 acres of soils capable of supporting agricultural production
10-50 Acres	50% soils capable of supporting agricultural production
50+ Acres	25 acres of soils capable of supporting agricultural production

Source: Comprehensive Farmland preservation Plan 2008, Frelinghuysen

Figure 4.34: Farm parcels that meet SADC Criteria for Soils



Source: Comprehensive Farmland preservation Plan 2008, Frelinghuysen

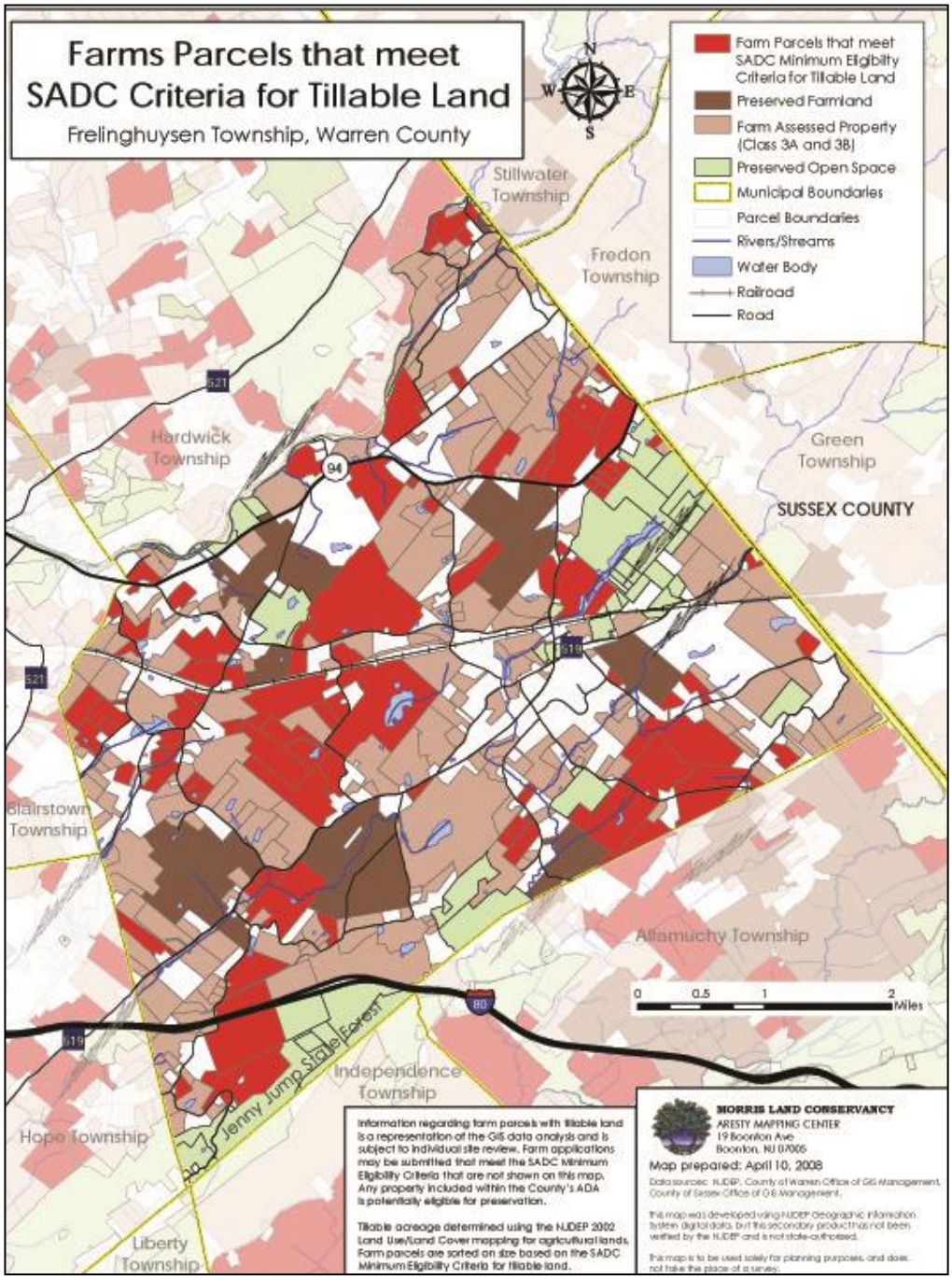
Farmland that meets the SADC criteria for tillable land (Table 4.3)

Tillable acreage was determined using the N.J. Department of Environmental Protection 2002 Land Use/Land Cover mapping for agricultural lands. Farm parcels were sorted on size based upon the State Agriculture Development Committee (SADC) Minimum Eligibility Criteria for tillable land. Figure 4.34 shows the parcels which meet SADC criteria for soil quality and figure 4.35 indicates the farm parcels that meet SADC criteria fir tillable land in Frelinghuysen. Finally, figure 4.36 has an overview of criteria, soil and tillable land.

Table 4.3: SADC criteria for tillable land

Farm Size	Requirements
0-6.667 acres	75% tillable
6.667-10 acres	5 acrestillable
10-50 acres	50% tillable
50+ acres	25 tillableacres

Figure 4.35: Farm parcels that meet SADC Criteria for tillable land



Source: Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

Farmland that meets SADC criteria for both tillable land and soils

Utilizing the tillable acreage determined from the N.J. Department of Environmental Protection 2002 Land Use/Land Cover mapping for agricultural lands and soil acreage determined using the Soil Survey as prepared by the Natural Resource Conservation Service for prime farmland soils, soils of statewide importance and soils of unique importance, farm parcels were sorted on size based upon the State Agriculture Development Committee (SADC) Minimum Eligibility Criteria for tillable land and soils. The Project Area Summaries and the farmland meeting the Minimum Eligibility Criteria for each project area are presented in the Tables and GIS Maps. As stated earlier, for each category, the land area within each project area is expressed as a ratio between the total acreage for each category and the total acreage of the project area. Also included is the percentage of each category expressed as a percentage of the total project area. As an Example in "Hope Preservation" project area table 4.4 describes the situation.

Table 4.4: Hope Preservation area characteristics

Hope Preservation Area	Acreage	Density Ratio			Percentage
Total Acres in Project Area	1,245				
Total Preserved Farmland	331	331	:	1,245	26.60%
8-Year Farms	0	0		1,245	0%
Total Open Space	2	2	:	1,245	0.15%
Prime, Statewide, Unique Soils	331	331	:	1,245	26.59%
Qfarm Parcels with Productive Soils	114	114	:	1,245	9.12%
Qfarm Parcels with Tillable Land	89	89	:	1,245	7.13%
Qfarm Parcels with Soils and Tillable Land	0	0	:	1,245	0%

Source: Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

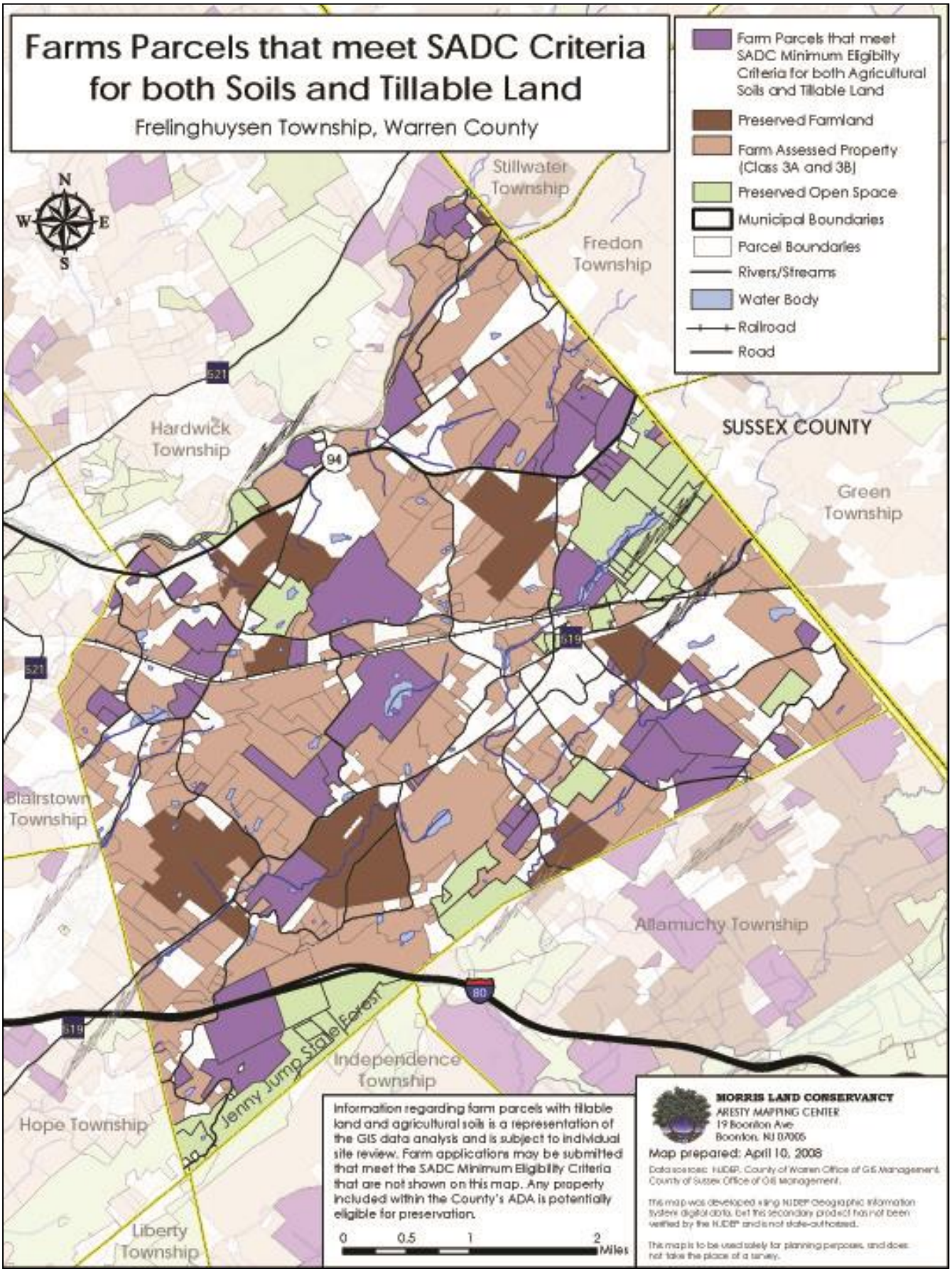
4.3.20 County and municipal ranking criteria

This is the third type of tools in scientific eligibility tools. The Warren CADB currently utilizes the state ranking criteria as the basis for calculating the rank of each farm. The CADB has developed its own Ranking Sheet that determines each of the following for individual applicant farms:

•quality of the local soils
•total tillable acres available
•local buffers and boundaries
• zoning
• County growth and existing infrastructure
•municipal commitment to agriculture
•other financial commitment to agriculture

As the County transitions to the new County Planning Incentive Grant program, the CADB will be using the State's minimum eligibility criteria as the basis for ranking farms for preservation. In special cases where a farm is of special interest and the CADB purchases land without state funding, it may consider using its current ranking form to prioritize farmland for preservation.

Figure 4.36: Farm parcels that meet SADC Criteria for both soils and tillable land



Source: Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

The Frelinghuysen Township Farmland Preservation Committee currently considers the following criteria when prioritizing farms for preservation in the Township as part of the Municipal PIG program:

•quality of the local soils
•proximity to existing preserved lands
•continuity of farmland corridors
•existing infrastructure for farm operations
•hybrid of both open space and farmland preservation
•small, viable farms
•willing sellers
•regional connectivity

The Township and County will continue to coordinate closely on all farmland preservation applications. Submittal of applications to the County and State will be dependent upon the availability of funding from not only the Township, but the County and State as well.

4.3.21 The result of scientific eligibility tools

There are **10,275 acres** of total assessed farmland in Frelinghuysen Township. According to the 2005 New Jersey Farmland Assessment, there are **5,411 acres** of active agricultural acreage in the Township, which accounts for 53% of the total assessed farmland. Of the total assessed farmland in the Township, **2,299 acres** meet the soils and tillable land Minimum Eligibility Criteria, based on the GIS parcel-based analysis. Thus, 22% of the total assessed farmland in the Township, and 42% of the active agricultural acreage, meets the SADC's Minimum Eligibility Criteria.*Of the 2,299 acres, **1,504 acres** of farm assessed land (Q Farm Parcels) are located within the municipal Project Areas. Thus approximately 15% of the total assessed farmland, and 28% of the active agricultural acreage, located in the Frelinghuysen Project Areas meets both the soils and tillable land Minimum Eligibility Criteria. In addition to the State's new Minimum Eligibility Criteria, the SADC has also identified an "Eligible Farm" standard as defined in the newly adopted rules. In this case, grant funding will be based upon an individual farm having a rank score that is "*equal to or greater than 70% of the county's average quality score of all farms granted preliminary approval by the SADC through the county easement purchase program and/or the county planning incentive grant program within the previous three fiscal years*." The SADC has released this rank score for Fiscal Year 2009 for Warren County, the minimum score for an Eligible Farm is 38.

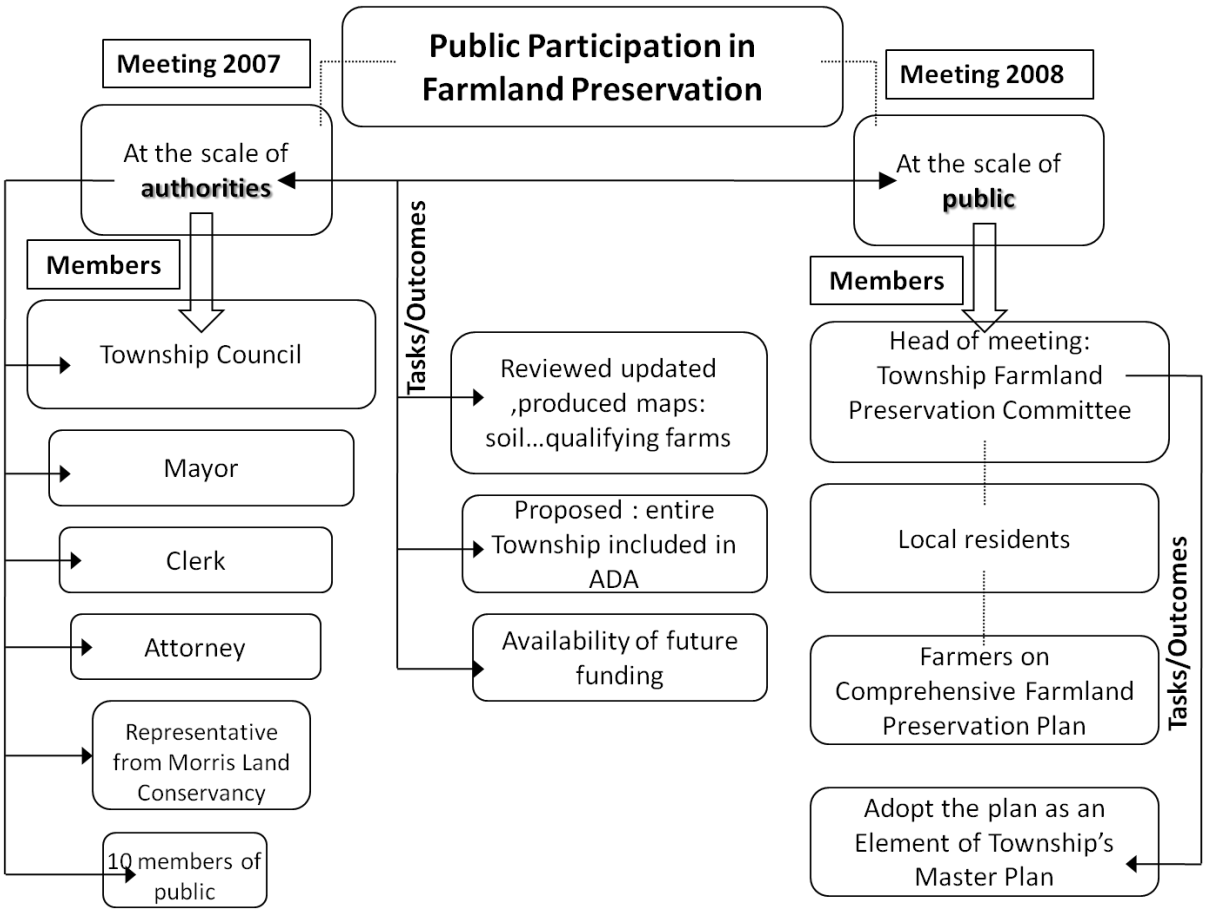
4.3.22 Public participation in preservation

For the development of this Comprehensive Farmland Preservation Plan, Frelinghuysen Township hosted two public meetings (one in 2007 and the second one in 2008) seeking input and direction from local residents, farmers, officials, and representatives of agencies and nonprofit organizations interested in farmland preservation. The first meeting was held towards the beginning of the plan development and the second meeting was held after the Draft Plan had been released to the public, in order to receive comments on the Draft Plan.

The first public meeting on the Frelinghuysen Township Comprehensive Farmland Preservation Plan Update was held on Wednesday, November 21, 2007, at the Frelinghuysen Township Municipal Building in Johnsonburg, New Jersey. The Township Council, Mayor, Clerk, and Attorney were in attendance as well as approximately ten members of the public and a representative from Morris Land Conservancy. Attendees reviewed the updated maps produced for the farmland plan, including a soils map, farmland map, project areas map, and a qualifying farms map. Attendees proposed that the entire Township be included within the Warren County ADA, and that the Township's proposed project areas be amended to include municipal-owned farmland. Concerns were expressed about the changes to the Farmland Preservation program, including the requirement for a County-level Agricultural Development Area (ADA) and the availability of future funding. There were questions about the deed restriction process associated with farmland preservation and concerns were expressed that this deed restriction could possibly be undone in the future at the State's discretion.

The Frelinghuysen Township Farmland Preservation Committee held a second meeting on May 5, 2008 to gather input from local residents and farmers on the Comprehensive Farmland Preservation Plan. This meeting was hosted by the Frelinghuysen Township Planning Board in order to adopt the Plan as an Element of the Township's Master Plan. The summary of the public participation through holding public meetings are shown in figure 4.37 designed by the author.

Figure 4.37: Public participation through holding public meetings and hearings in Frelinghuysen preservation plan



Source: After Comprehensive Farmland preservation Plan 2008, Township of Frelinghuysen

4.3.23 Factors limiting farmland preservation implementation

Rising Land Values: The value of a development easement in Frelinghuysen Township has increased from$3,800 an acre in 2003 to $5,200 an acre in 2006, revealing a 47% increase in three years

Limited Eligibility with State Farmland Program: Of the 10,275 acres of total assessed farmland in Frelinghuysen Township, only 1,504 acres in the municipal Project Areas meet both the soils and tillable land Minimum Eligibility Criteria for farmland preservation as defined by the SADC. Thus, less than15% of the existing farmland in Frelinghuysen is eligible for State funding.

Landowner Interest: While Frelinghuysen farmers remain interested in farmland preservation, several misconceptions may deter them from protecting their farms. Local farmers have voiced concerns regarding the deed restriction process associated with farmland preservation and questioned how their rights as landowners may become limited under farmland preservation.

Local Support for Farmland Preservation: Farmland preservation has traditionally been a top priority for Frelinghuysen Township. In the past, residents have approved all referendums related to farmland protection.

However, in November 2007, Frelinghuysen voters did not approve a ballot measure to increase Township's Open Space and Farmland Preservation tax from two cents ($0.02) to four cents ($0.04) per $100 assessed property value. The measure was defeated by an almost 2:1 ratio. This ballot results may indicate a shift in local support for land preservation but more likely is a statement against rising property taxes and misconceptions regarding land preservation.

4.3.24 Preservation goals in the future

The Farmland Preservation Committee meets its mission through education, preservation, and support of the local farmer and by assisting farmers with farmland preservation initiatives including the municipal, county and state programs. The Committee supports growth near existing villages and non-agricultural areas, and encourages residents to view preservation as an opportunity to protect existing farmland and environmentally sensitive regions through appropriate farming practices. To date, there are 1,433 acres of permanently preserved farmland in Frelinghuysen Township. This represents 14% of the land under farmland assessment in 2007.

Frelinghuysen Township is 15,277 acres (23.9 square miles) in size. Of this, 10,275 acres are under farmland assessment, which includes croplands, woodlands, farm structures and wetlands/waterways that occur on an agricultural property. Since 1998, Frelinghuysen Township has preserved 1,433 acres of farmland. Using the 10,275 ac residentified as farm assessed properties, this leaves 8,842 acres of unprotected farmland remaining in Frelinghuysen, or 86% of the Township's agricultural base. Frelinghuysen Township has set ambitious goals for their Farmland Preservation Program. The Farmland Preservation Committee has set a target goal of preserving 2,433by 2017. Of the 10,275 acres of assessed farmland in the Township, 2,299 acres meet the State's Minimum Eligibility Criteria for soils and tillable land, based on a GIS parcel analysis. Of the 2,299 acres that meet the criteria, 1,504 acres of farm assessed land are located within the municipal Project Areas. Based on the amount of farmland that met Minimum Eligibility Criteria and available funding to purchase and preserve farmland, the preservation goals are identified for Frelinghuysen Township as for one year target 100 acres; Five year target 500 acres and Ten year target 1,000 acres.

4.3.25 Conclusions

Frelinghuysen is an example of a comprehensive and detailed preservation system in which almost all the aspects of the city has been taken into consideration. It can be noticed as the most systematic, multidimensional and dynamic preservation structure which is every couple of years updated and improved. The structure shows how the whole city should participate in conservation and this target cannot be aimed under the responsibility of one organization.

The farmland preservation plan has strong basic studies as it starts reviewing all the fundamental problems which lead to producing a necessary preservation plan and prevent the ongoing wrong procedures. Though an organized research on farmland loss, land use conversions, population growth and the shortage of agricultural products for the increasing population the problem has been identified and afterwards the preservation plan has been suggested as a solution. This process highlights the necessity of preservation plans in Frelinghuysen as well. There has been a big emphasize on the shortage of agricultural products with increasing population trend and the economic consequences it brings for the township which can be an applicable approach in Iran. As most of the plans concerning preservation have a strong ecological base, it is hard to justify the investor or government in a developing country how important the air pollution or climate change is. Nevertheless opening the important subject of economy and the costs the government will be able to save indirectly can be a better solution to stress the importance of farmlands preservation and investment on this field.

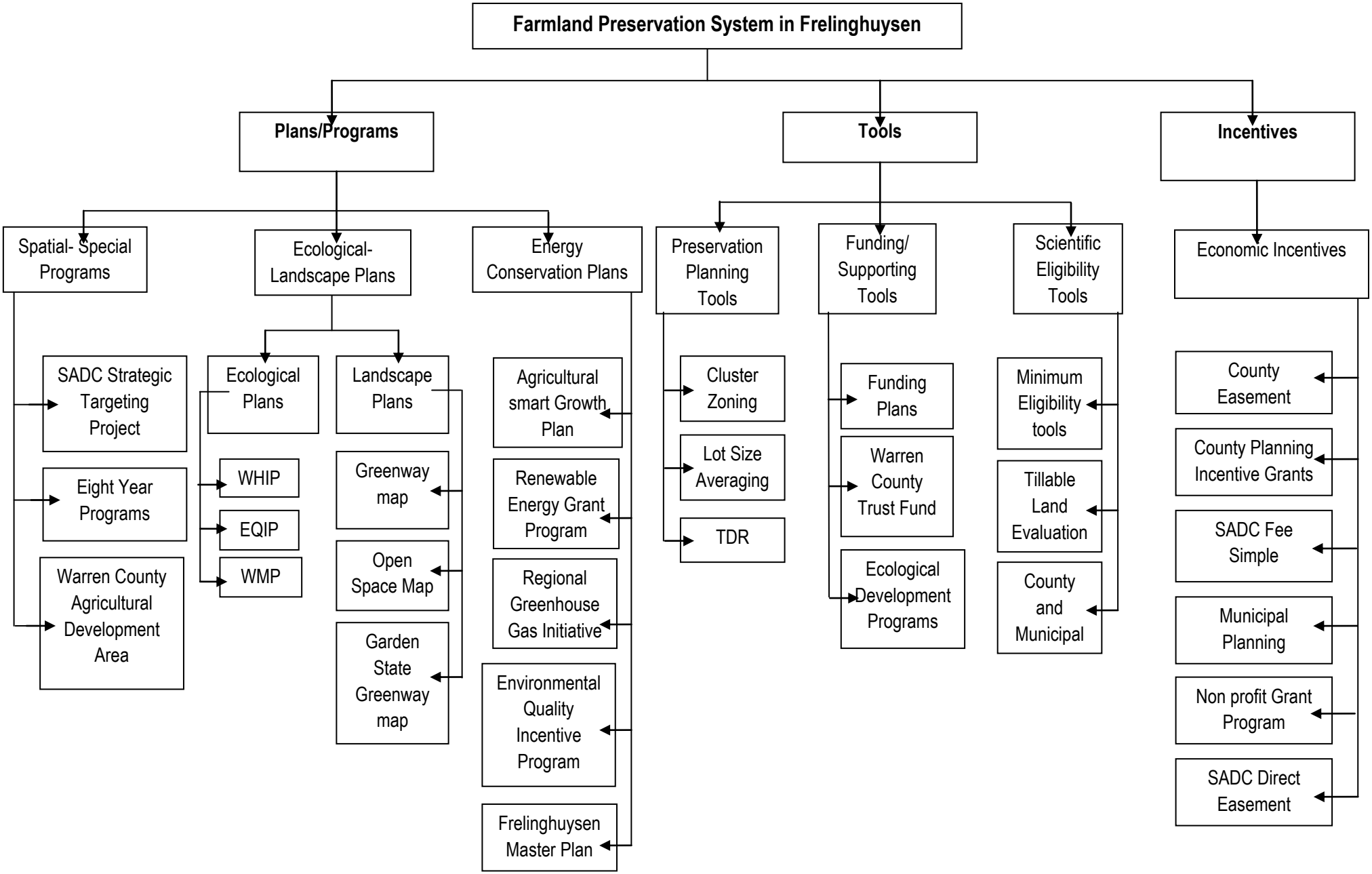
Although there are various preservation programs in the system the main organizations are clear and few with understandable structure; SADC as the main and NJDA as supportive. Figure 4.38 shows the programs, plans, tools and incentives which try to simplify the farmlands preservation which are presented by different organizations which do not interfere the function of the main two bodies. The structure proves that for a successful preservation there should be plenty of supporting programs but the management structure should not

be overloaded with different organizations. Moreover there has to be economic incentives as well as scientific tools. Without science the base and methodology will be weak and therefore unreliable. In Tehran example with insufficient budget this is a significant point which should be implemented to select and enter the most important green lands in the system and to give the priority to the lands which are more endangered. In addition such a process can be any time defendable.

Supporting agriculture is a big step to have successful preservation as well. As in Frelinghuysen Economic Development Program helps the famers even in poor harvest seasons and shares the risk of farming, farmers obtain more motivation to keep the farm and this is one of the outstanding participations that the preservation needs from farmers' side. Beside economic support this participation needs education. When the people's knowledge is high enough to perceive the role of farmlands and their influence on our future lives, they can be easier justified to choose farm instead of building apartments and knowledge needs cultural-educational programs to enhance the green mentality especially at school level or neighborhood meetings. In this area Frelinghuysen has had a big success whereas Iran is at the first stages.

Another characteristic of this plan is the deep research it conducted on the existing urban plans to clarify the status of agriculture in the Frelinghuysen urbanism and to be consistent with them in the planning phase. This point is often missing in Iran preservation plans as well. They usually either ignore or do not accept what other plans have achieved in the past. The only plans that urban planners have to obey legally are detailed plans and even for this plan Commission Code 5 can simplify the process if necessary.

Figure 4.38: Preservation Plans/Tools and Incentives in Frelinghuysen

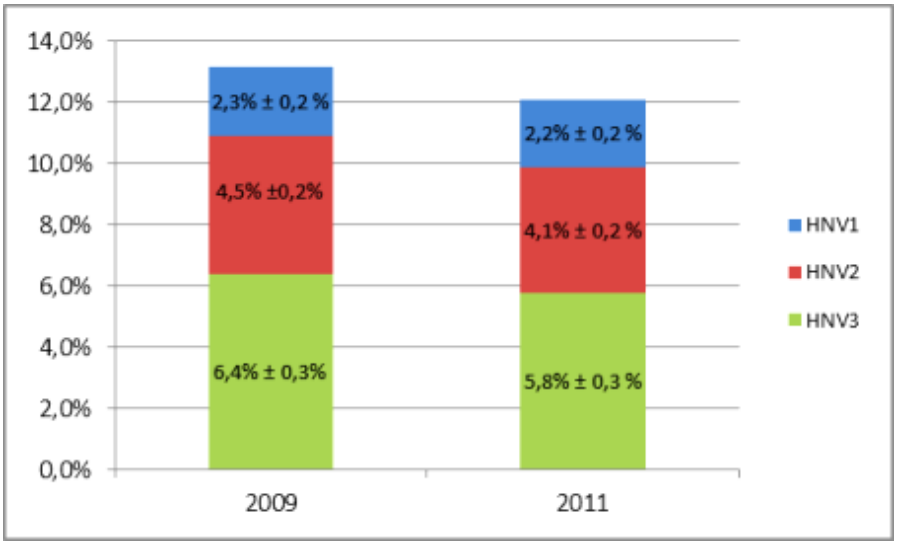


4.4 The German preservation system

"Farmland covers about 50% of the total area of Germany. Therefore, agriculture has a considerable influence on the biodiversity of the open landscape. Progressive agricultural intensification has led to a dramatic decrease of low-intensity farmland and agricultural biodiversity after the mid-20th century (Federal Agency for nature conservation, 2014)." "The German landscape is intensively used for agriculture. There are almost no regions which are used predominantly for extensive agriculture. But in almost all regions of Germany there are areas of varying sizes that are used extensively, and can be regarded as HNV[1]-farmland.

In Germany, a specific methodological approach to determine and evaluate the amount of HNV Farmland has been adopted. Both the federal government and the states agreed on field surveys for compiling the data for the HNV farmland indicator (Institut für Agrarökologie und Biodiversität, 2014)." "As an objective-related baseline indicator, the HNV farmland indicator must be reported to the EU by all member states. Data for the HNV farmland indicator have been gathered in field surveys, using some 900 sample plots throughout Germany each covering one kilometer square. The BfN developed the survey design for an initial nationwide survey of HNV farmland in consultation with the German states. The survey instructions define the open countryside structures used in extrapolating the indicator, such as grassland, vineyards, arable land and landscape elements. The nature values of grassland, arable land, fallow land and vineyards are measured against lists of indicator species.The identified HNV farmland structures were assigned scaled nature: HNV I represents on exceptionally high nature value, HNV II a very high nature value and HNV III a moderately high nature value. Figure 4.39 shows that the proportion of HNV is unequally distributed with regard to the quality levels and that the indicator value tends to decrease with the highest decline in the lowest level. The highest quality level remains static with a low value (BfN, 2014)."

Figure 4.39.The proportion of three types of HNV in Germany in 2009 and 2011

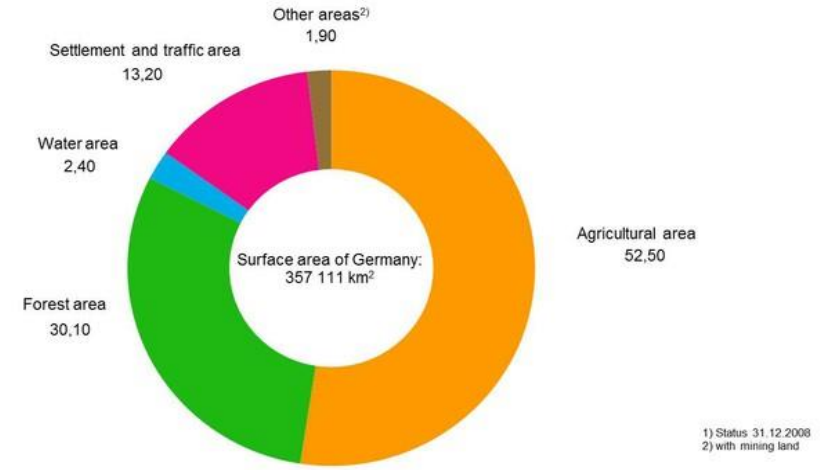


Source: Federal Agency for nature conservation, 2014

As can be seen in figure 4.40, in 2008 agriculture accounted for 52.5 % of the surface area – 18 764 594 ha, including moorland and heath land areas and has decreased slightly since 2004. The settlement and traffic areas in Germany grew by 104 ha/day from 2005 to 2008. This was slower than from 2004 to 2007, when growth was running at 113 ha/day. This growth was achieved largely at the expense of areas used for agricultural purposes; therefore for all the two described reasons in its national sustainability strategy, Germany has set the target of achieving a reduction in as shown infigure 4.41 (European Environment Agency, 2010).

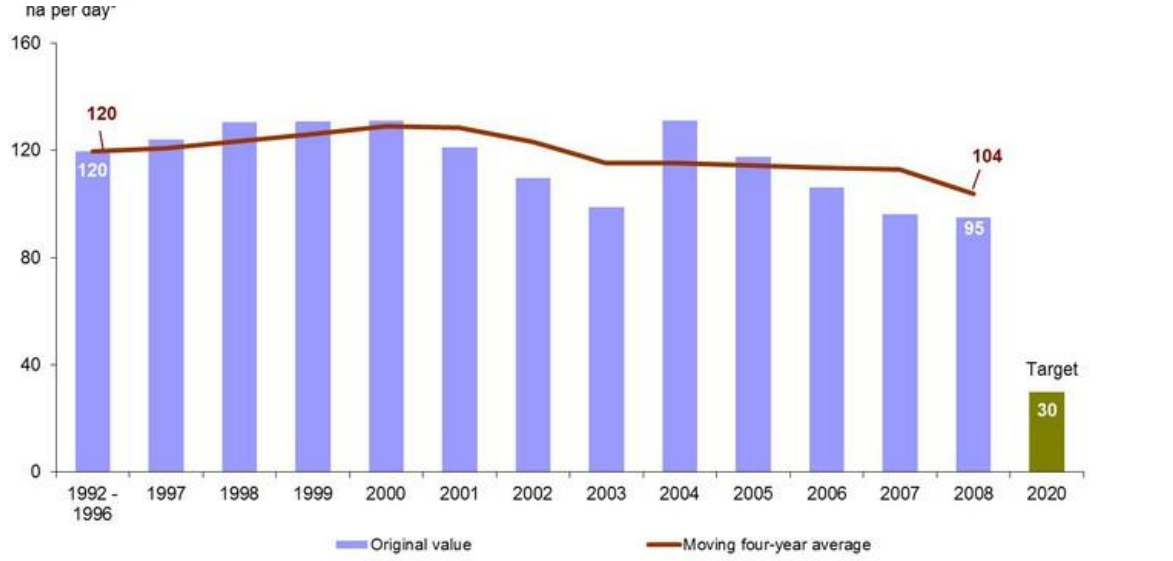
[1] High Nature Value

Figure 4.40: Land use chart in Germany, 2008



Source: European environment agency, 2010 quoted after Federal Statistical Office, Land area by type of actual use, 2008

Figure 4.41: Increase of settlements and traffic area in Germany, 1992- 2008



Source: Federal Statistical Office, Federal Office for Building and Regional Planning, 2009 quoted after European environment agency, 2010

Similar to other densely populated countries, there is a general interest in Germany in the preservation of undeveloped land or open space. In contrast to other countries, however, Germany has formulated a quantitative national target for land-use control. In order to decelerate the conversion of undeveloped land and to preserve open areas, the German Federal Government has made a commitment to reduce the growth of settlement and traffic areas from recently 113 ha (2004–2007) to 30 ha per day by 2020 (Henger and Bizer, 2009, p.843 quoted after Statistisches Bundesamt, 2008).

Economists and planners in Germany have therefore turned their attention to more flexible approaches containing integrated market mechanisms that would lead to more efficient land-use allocation. Unlike other developed countries, Germany's land-use planning system has not included integrated market-based strategies up to now. Other countries have meanwhile gained experience in market-based instruments, such as transferable

development rights (TDR) (Henger and Bizer, 2009, p.843 quoted after Mills, 1980; Johnston and Madison, 1997; Pruetz, 1997, 2003).

Traditionally, land-use planning in Germany has always had a strong legal position. Each local authority defines land-use categories for the territory under its control and regulates residential, commercial, industrial and recreational development. At local level, this type of planning is realized in a two-step process: (i) the preparatory land-use plan expresses the municipality's determination to modify existing areas; (ii) the development or zoning plan defines the detailed rights of construction for each individual plot in a built-up area. The local planning process is incorporated in comprehensive planning at regional, state (Länder) and national level (e.g., Heinrichs, 1999). Lower level plans must consider higher level objectives and principles, and vice versa. In recent years, 'regional planning' has become more important and is progressively viewed as a platform for new management approaches and strong containment strategies (Einig, 2003; Müller and Siedentop, 2004 quoted after Henger and Bizer, 2009, p.845). Regional plans require communities to direct demand into areas defined by urban containment boundaries or to explicitly protect open space from conversion outside these boundaries with greenbelts (Schulz and Dosch, 2005 quoted after Henger and Bizer, 2009, p.845). Spatial planning seems to have successfully directed development to certain areas, but has been unable to prevent low density development with unlimited outward expansion (Henger and Bizer, 2009, p.845 quoted after Siedentop et al., 2009).

4.4.1 Essen

The city of Essen comprises a population of 566.862 and the area of 210.3 km^2. Figure 4.42 shows its local regions[1] and districts[2]. Founded around 845, Essen has been one of Germany's most important coal and steel centers until the 1970s and attracted workers from all over the country; it was the 5th-largest city in Germany between 1929 and 1988, peaking at over 730,000 inhabitants in 1962. Since then, the city developed a strong economic tertiary, so it is sometimes called "desk of the Ruhr area". As far as population and size, Essen is not comparable with Tehran but the main objective of this part is to know the urban system, regulations, laws and preservation plans which do not necessarily depend on the size of the city. "Federal Building Code"[3] is an urban reference which provides clearly defined regulations for all city sizes at different management levels. Therefore, successful approaches in Essen can be transformed to Iran according to the current urban situation and the social and cultural circumstances as well.

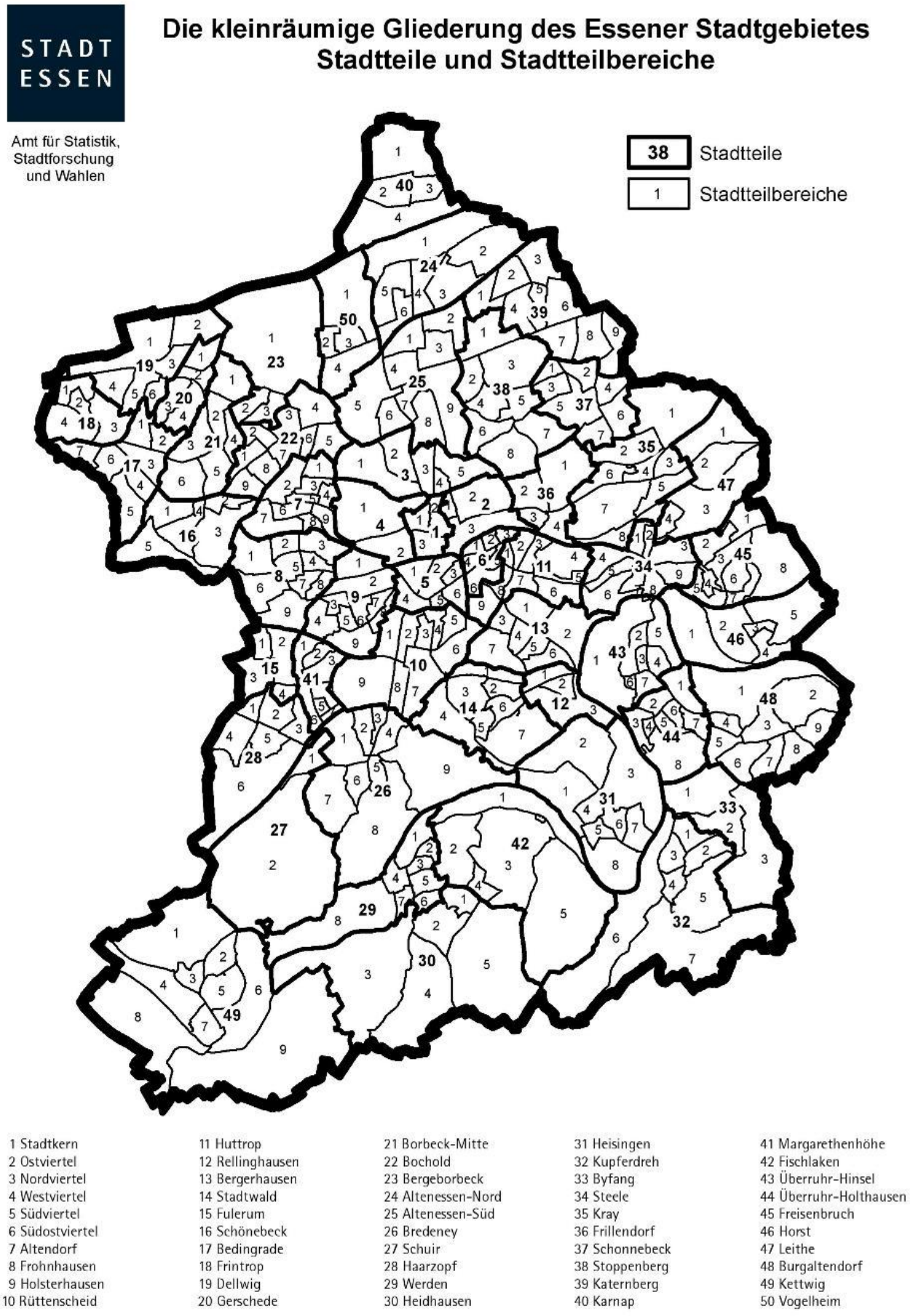
In addition, there are other factors which led to choose Essen as an appropriate city for the current study. First of all Essen is the third greenest city in Germany, and with 9.2 percent green lands, Essen is the greenest city in the state of North Rhine-Westphalia in Germany. It has more than 700 green areas and not only for recreational but also extensive for leisure areas. Moreover Essen contains about 1750 hectares of woodland, certified in accordance with the ecological FSC[4] standard and, finally, the city of Essen polluted by the factories 15-20 years ago has improved the quality of life by the green approach in the management system. This last situation can be compared with Tehran with the current problem of high air pollution and too many in vain projects.

4.4.2 Urban planning in Essen

As explained, urban planning in Germany is hierarchical. In this concept on each urban planning level a specific plan is being produced (Figure 4.43) and the status of Essen in the German planning system is shown. Figure 4.44 shows the characteristics of the different plans in Germany whereas figures 4.45 to 4.47 illustrate these plans.

[1] Stadtbezirke
[2] Stadtteil
[3] Baugesetzbuch
[4] Forest Stewardship Council

Figure 4.42: Local Regions and district of the city Essen

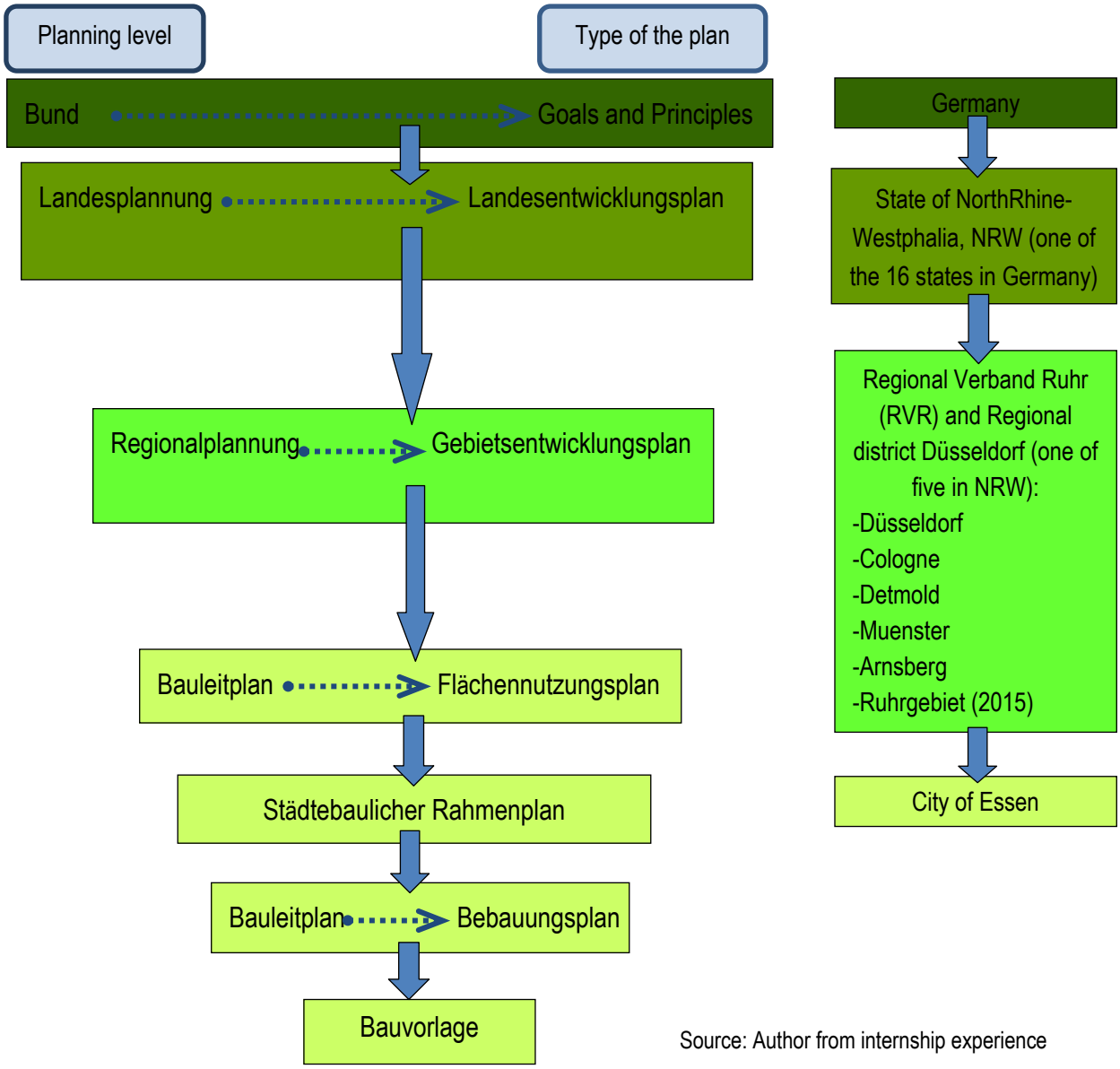


Source: Stadt Essen, 2013

In figure 4.44 the plans are categorized by scale and the important distinguishing characteristics are explained. The Landesentwicklungsplan is the plan at the highest level which follows the goals and principles from the federal government[1] and is allocated to each state. It has a legal base in ROG[2] or Regional Development Law and specifies the guidelines for regions and municipalities. The scale depends on the size of the state; its decision maker board is the Regional Council whereas the Federal Government must approve it.

The Gebietsentwicklungsplan which is legally based on ROG and LPIG[3] has its boundaries limited to the administrative districts and is approved by MWME or the Ministry for Economy, Middle class and Energy for the State of NRW. The Regionaler Flächennutzungsplanstems from ROG, LPIG and BauGB or Federal Building Code and is a depiction or display of how land uses of the six neighbor cities look like (more details in the next parts). The Flächennutzungsplan is the land use plan of one city. The Städtebaulicher Rahmenplan which belongs to the territory of a city has a text part and a plan part which clarifies the future possible urban development of the city. The last plan is Bebauungsplan which is the only plan with a strong legal character for a city district, a neighborhood or a group of parcels and gives information about the land use and the construction qualifications of each parcel according to the law.

Figure 4.43: Planning levels in Germany (left side) and the status of Essen in the German planning system (right)



Source: Author from internship experience

[1] Der Bund
[2]Raumordnungsgesetz
[3] Landesplanungsgesetz

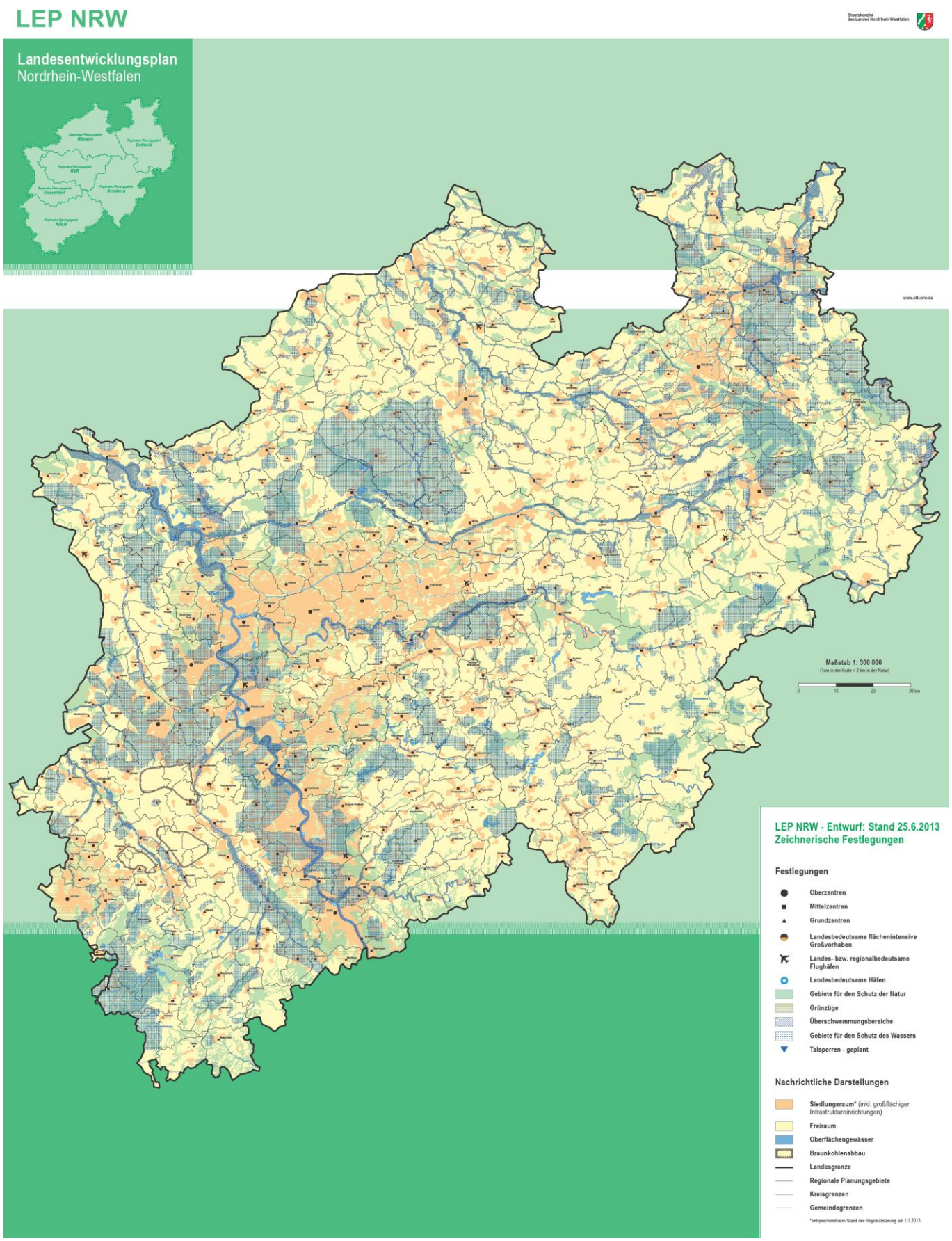
Figure 4.44: Characteristics of different urban plans in Germany

Pläne/ Qualifikationen	Landesentwicklungs-plan	Gebietsentwick-lungsplan[1]	Regionaler Flächen-nutzungsplan[2] in NRW	Flächen-nutzungsplan[3]	städtebaulicher Rahmenplan	Bebauungsplan
Gesetzliche Grundlage[4]	ROG	ROG, LPlG	BauGB, ROG[5], LPlG[6]	BauGB	BauGB	BauGB, BauNVO
Abgrenzung[7]	Länder	Regierungsbezirk bzw. Teilabschnitte der Regierungsbezirke	Stadtgebiete von mind. 3 Gemeinden im Ruhrgebiet	Stadtgebiet einer Gemeinde	Stadt	einen Teil des Gemeindegebietes, etwa eine Gruppe von Grundstücken oder einen Stadtteil
Inhalte[8]	allgemeinen Richtlinien für die weiteren Planungen der Länder, aber auch der Regionen und Gemeinden	Ziele und Grundsätze der Raumordnung	Ziele und Grundsätze der Raumordnung + Darstellungen zur Flächennutzung	Darstellungen zur Flächennutzung	Textteil und Planteil, dienen der vereinfachten Darstellung von zukünftigen städtebaulichen Planungs- und Entwicklungsmöglichkeiten	die bauliche und sonstige Nutzung der Grundstücke in der Gemeinde vorzubereiten und zu leiten
Maßstab[9]	Hängt von dem Land ab	1:50.000	1:50.000	1:10.000 oder 1:15.000	1:500 oder 1:1000	1:500 oder 1:1000
Beschließen-des Gremium[10]	Regionalrat	Regionalrat	Räte der Gemeinden	Rat der Gemeinde	Gemeinderat	Gemeinde
Genehmigungsbehörde[11]	Landesregierung	MWME[12]	MWME	Bezirksregierung	-	-

Source: Stadt Essen completed by the author, 2013

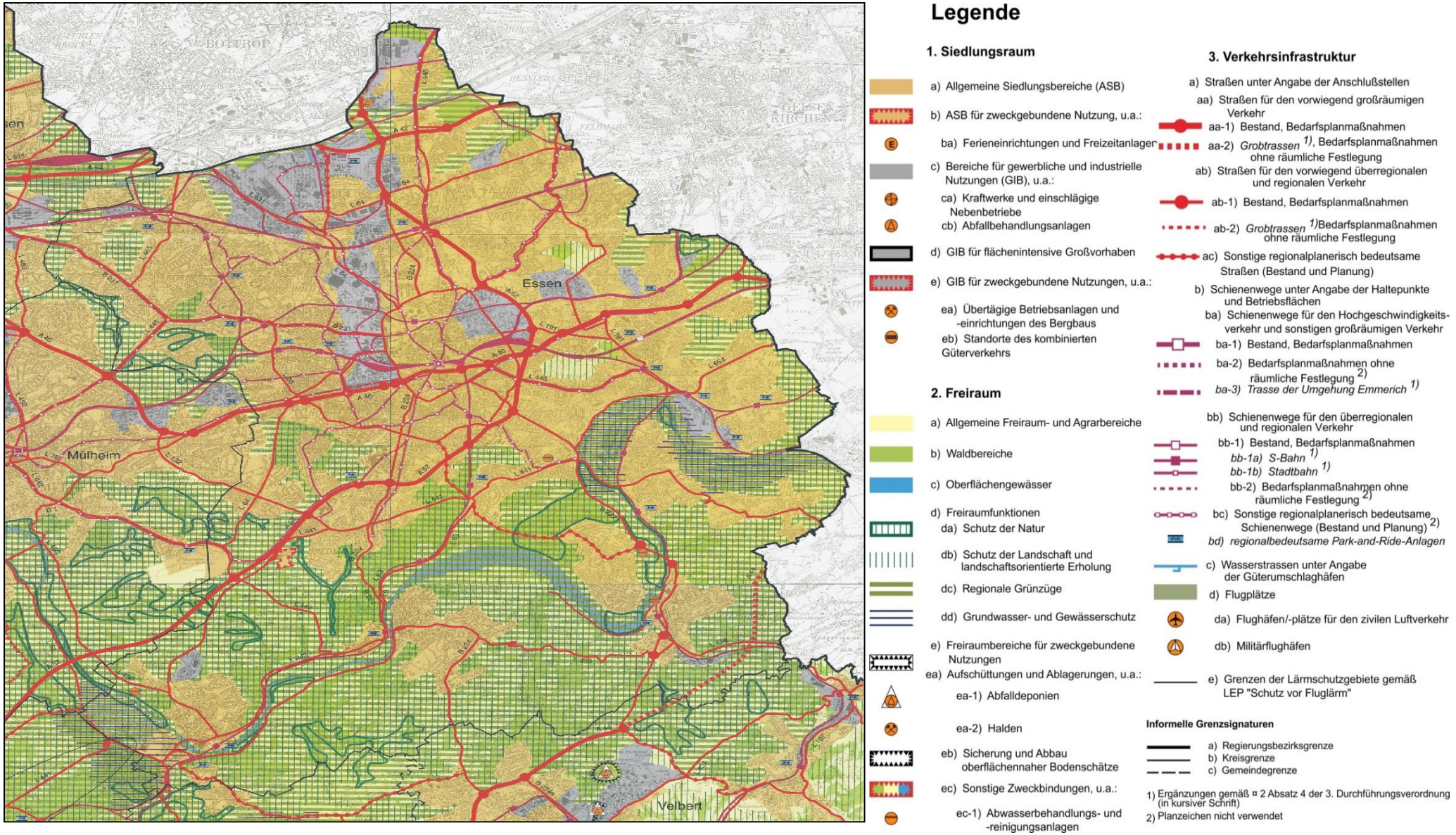
[1] Regional Development Plan
[2] Regional Land Use Plan
[3] Land Use Plan
[4] Legal base
[5] Raumordnungsgesetzor regional Planning
[6] Landesplanungsgesetz or Federal State Planning
[7] Boundary
[8] Content
[9] Scale
[10] Decreeing Board
[11] Approval Authority
[12] Ministerium für Wirtschaft, Mittelstand und Energie des Landes NRW

Figure 4.45: Landesentwicklungsplan the highest level plan in Germany produced in state planning (Landesplannung) level



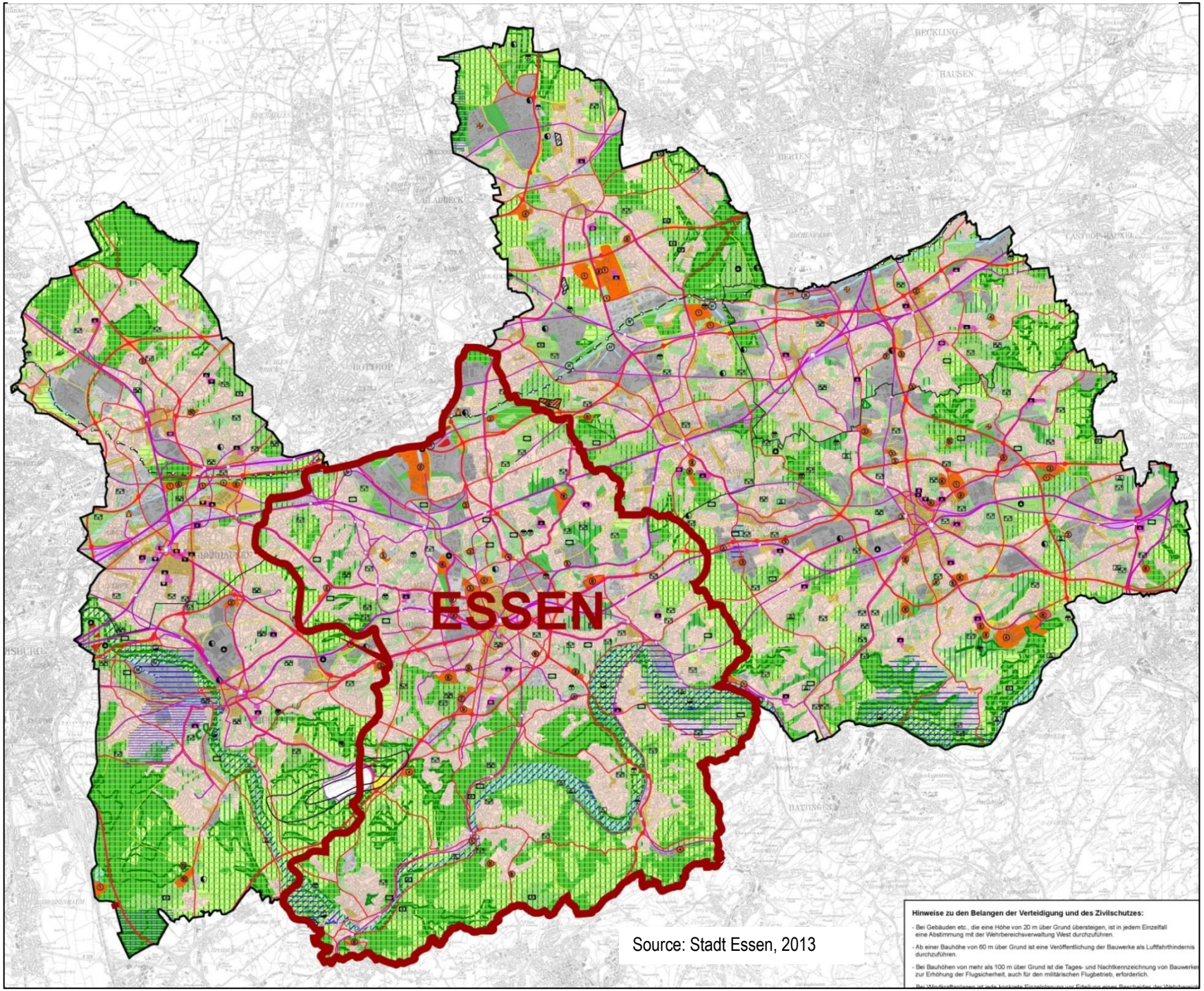
Source: Stadt Essen, 2013

Figure 4.46: Gebietsentwicklungsplan, the second highest level plan in Germany produced at regional planning level



Source: Stadt Essen, 2013

Figure 4.47: Regionaler Flächennutzungsplan der Planungsgemeinschaftstädteregion Ruhr (Bochum, Essen, Gelsenkirchen, Herne, Mülheim an der Ruhr und Oberhausen



Legend of figure 4.47: Regionaler Flächennutzungsplan der Planungsgemeinschaftstädteregion Ruhr (Bochum, Essen, Gelsenkirchen, Herne, Mülheim an der Ruhr und Oberhausen

The Regionaler Flächennutzungsplan (RFNP) which is not designed in the frame of planning levels shown in figure 4.43 is a combination of the Flächennutzungsplan of six cities Bochum, Essen, Gelsenkirchen, Herne, Mülheim an der Ruhr and Oberhausen. The scale of this map is that of the GEP[1] (1:50.000) and not that of the Flächennutzungsplan (1:15.000 or 1:10.000), but there is a display threshold of 5 hectares (whereas it is10 hectares in the GEP). Thus the RFNP is a plan legally substituted for the six separate FNPs of the mentioned cities which has a resolution between the GEP and the FNP.

4.4.3 Compensational land pool in Essen

The concept of the "Ersatzflächenpool" or compensational land pool in Essen is based on the approach that there should always be a balance between green and brown fields in the city. This concept is based on § 6 Absatz 8 Landschaftsgesetz NW, Landschaftsrecht (§§4a and 5 Landschaftsgesetz) and §§ 39 and 43 Landesforstgesetz.

When there are negative impacts of urban developments and constructions on nature and environment, they would be compensated by the Ersatzflächenpool (Figure 4.48). Priority is given to parcels in the local region of construction; i.e. that in the first stage a space will be searched that can be turned into green in this local region. If there is no free space inside this local region, the parcels elsewhere in the city of Essen can be taken into consideration. Figure 4.49 shows how the Greenland Organization in Essen tried to compensate the green space loss in the city by calculations in the Eingriffs-/Ausgleichskataster.

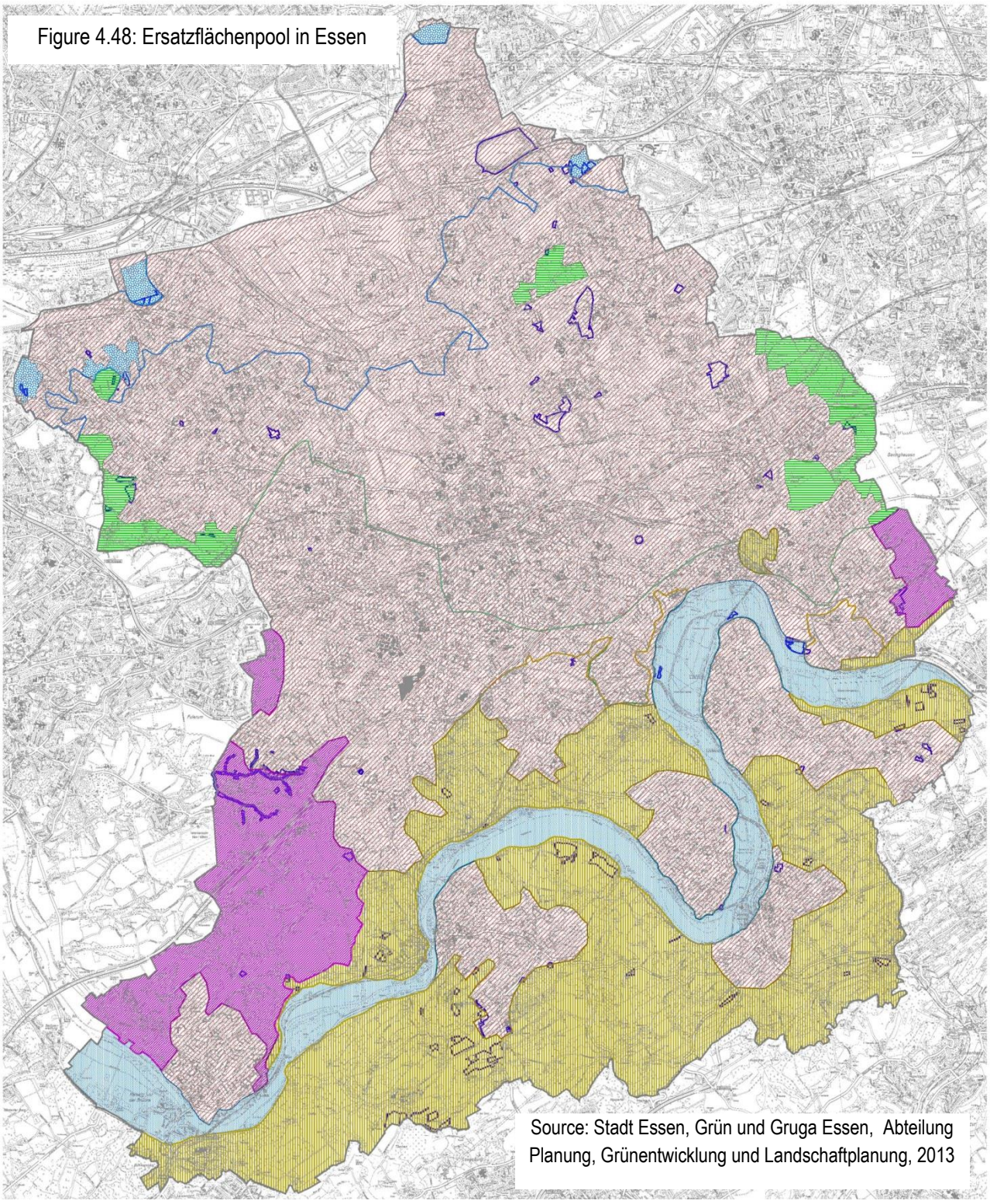
This system has worked perfectly to keep the balance between green and built-up areas in Essen with almost 50% each. This is a system which should operate with all of its elements, sometimes they can be shifted but they cannot be erased, i.e. there might be green areas destroyed in the pool but as there has to be always a balance between the two elements, this will be compensated by developing another green area in the local region. As the weather in Essen/ Europe gives this opportunity to grow plants easily and fast, this compensation does not take a long time. Following this rule has kept Essen going on an ecological track and at the same time given the development opportunities a potential chance wherever it is appropriate.

4.4.4 Green plans in Essen

Essen municipality started improving the quality of air/life years ago by implementing green plans which have been categorized below by the author according to the interviews with different authorities in the municipality[2], the Department for Environment[3] and the Department for Greenfield during her internship[4]. As shown in figure 4.50 there are five sorts of green plans in Essen. The first type is a spatial one. It is designated to a specific geographical area and works on the green spatial organization of that region. These kinds of plans started with 14 specific parcels in *Grüne 14* in 1974 which later turned into the base for another spatial plan, *Begrünung Essener Norden (BEN).* In 1974 the total area of 337 hectares has been shifted from these 14 parcels to BEN with the total budget of 101,5 Million DM. These plans were focused on the northern part of Essen since there was a lack of green spaces at that time whereas in the south there existed extensive forests and green lands. BEN had the intention to develop 55 parcels with the total area of 337 hectares in 1991 which cost the city 103,7 Million DM at that time. Currently, 35 parcels have completely and another 12 have partially been completed.

[1] Gebietsentwicklungsplan
[2] Stadt Essen
[3] Umweltamt
[4] The names of these people will be presented at the end of the research in references part

Figure 4.48: Ersatzflächenpool in Essen



Source: Stadt Essen, Grün und Gruga Essen, Abteilung Planung, Grünentwicklung und Landschaftplanung, 2013

Flächen für Maßnahmen entsprechend den landschaftsplanerischen Leitbildern im unbesiedelten Bereich nach dem "Essener Modell"

Maßnahmen sind in den landschaftsplanerischen Leitbildern konkretisiert und nach Landschaften und Nutzungstypen gegliedert.

Flächen für Maßnahmen entsprechend den stadtökologischen Leitbildern im besiedelten und bebauten Bereich

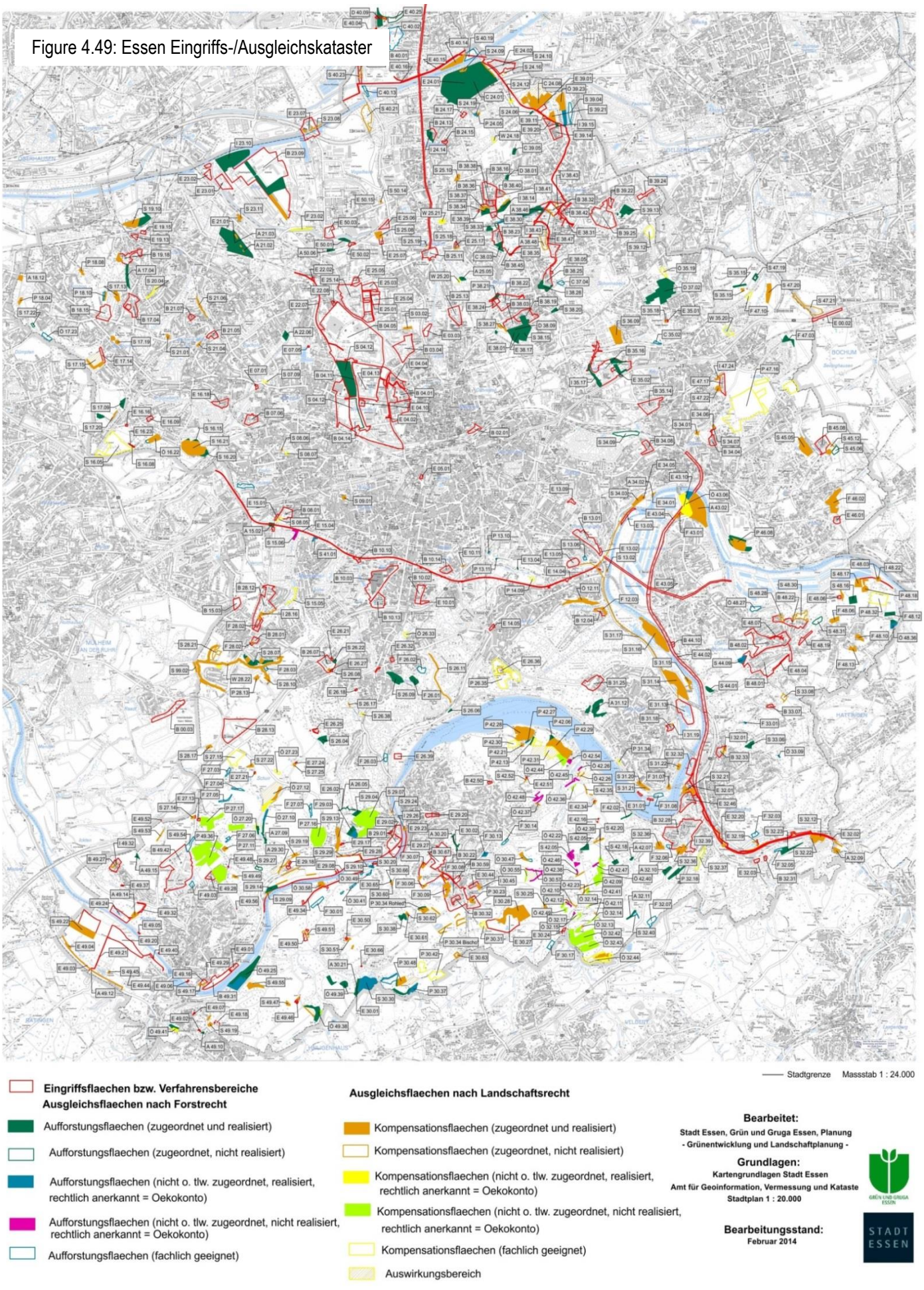
Abgrenzungen der Landschaften anhand der Bodenkarte von Nordrhein-Westfalen

- Grenze zwischen der Landschaft der Niederungsgebiete im Emscherland und der Landschaft der Lössgebiete im Unteren Westenhellweg
- Grenze zwischen der Landschaft der Lössgebiete im Unteren Westenhellweg und Oberen Westenhellweg
- Grenze zwischen der Landschaft der Lössgebiete im Oberen Westenhellweg und der Landschaft der Verwitterungsgebiete im Niederbergisch-Märkischen Hügellland
- Landschaft der Ruhraue

Landschaftsrelikte mit natürlichen Böden

- Niederungsgebiete im Emscherland
- Lössgebiete im Unteren Westenhellweg
- Lössgebiete im Oberen Westenhellweg
- Verwitterungsgebiete im Niederbergisch-Märkischen Hügelland
- Ruhraue

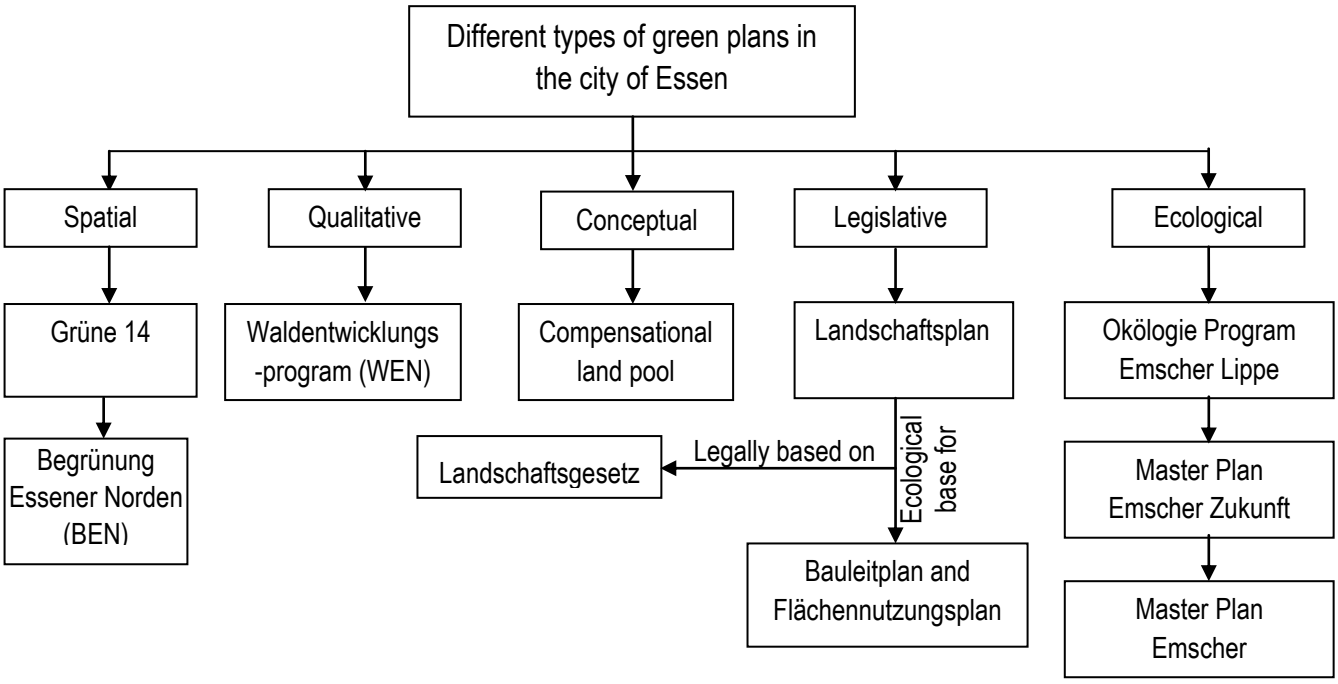
Figure 4.49: Essen Eingriffs-/Ausgleichskataster



Source: Stadt Essen, Grün und Gruga Essen, 2013

The second type of plans is specifically working on the quality of green lands in Essen. Waldentwicklungsprogram (WEN) organized by the Department for Greenfield attempted to preserve and develop forests between 1989 and 1999. In this plan the quality and the quantity of the forests were significant and with its help the quantity of forests could successfully been increased from 363 to 750 hectares. The compensational land pool which has been explained above is a part of the conceptual plans, since it origins from the concept of keeping the balance of green and brown fields in the city. The forth category of plans are the legislative ones which are the legal base of other urban plans. The Landschaftsplan is legally based on the Landschaftsgesetz and is itself the ecological base of the Bauleitplan and the Flächennutzungsplan. Therefore, the regulations in the urban plans are also based on the legal base which has been approved at state level (NRW) and are ecologically compatible with each other. The last type of green plans has ecological contents and is working specifically on Emscher River which is a relatively small tributary of the Rhine, flowing through the Ruhr area in North Rhine-Westphalia. The *Ökologie Program Emscher Lippe* is an aid program[1] established in 1991 and is provided with national funding[2] of 15 million Euros annually. Its aim is to improve the ecological circumstances of the Ruhr area. The 2005 and 2010 *Master Plan Emscher Landschaftspark* has been combined with the Okölogie Program Emscher Lippe. The 2003 *Master Plan Emscher Zukunft (EGLV)* tried to focus on separating rain water from sewage which has been a big problem of the Emscher River for the last 10 years. All these three plans are concentrated on the ecological aspects of Essen and are geographically connected with each other; therefore the Department for Greenfield has attempted to adjust the three plans in one direction and omit any possible conflict.

Figure 4.50: Green Plans in the city of Essen



Source: Author according to Interviews during Internship in Stadt Essen, 2013

The important point in this process is that although different organizations are working on green fields, they all are in connection with eachother to avoid parallel works, consider other projects in their own projects and try to be consistent with each other.Thus each step towards green space in Essen is in the green network area and not in a limited, isolated and separated section of the city. Even when the project is restricted to certain geographical boundaries, its connections with the green spaces beyond is taken into consideration.

[1]Förderprogramm
[2] Landesmittel

4.4.5 Court system in Essen urban planning

In German cities any citizen has the right to complain to the court and criticize the urban plans which have been approved and passed at higher authorities. If there is a failure in a plan which has been ignored by urban authorities or municipalities, the responsible organization/ department would have to pay the fine to the person and compensate loss or damage. These cases usually occur when there is a contrast/conflict between a new plan and the higher level plan which should have been followed. Following the hierarchy of courts the Administrative Court[1] in Gelsenkirchen deals with simple cases. The Higher Administrative Court[2] in Müsnter has juridical power when the court in Gelsenkirchen cannot solve the problem or the problem has more importance than can be solved at a lower level. Supreme Court[3] or Court of Federal Claims in Leipzig is the highest court within the hierarchy of many legal jurisdictions and the decisions of a supreme court are not subject to further review by any other court. This is also the hierarchy which should be followed when complaining to the court which means that the very first step is to go to the lowest level court in Gelsenkirchen for the problems concerning the city of Essen, and if they cannot be solved at this stage, they will be forwarded to higher levels.

The existence of different courts at different levels and the citizens' right to share ideas and complaints about their city problems prepares an appropriate ground for the reflection of citizens' ideas and therefore people participation in urban planning. On the other side, there will be indirect-automatic surveillance from citizens or the authorities which can be very positive and effective in planning processes and prevents corruption. In addition, urban managers would fulfill their duties more precisely, as the consequences of even small mistakes will cost the whole department high expenses.

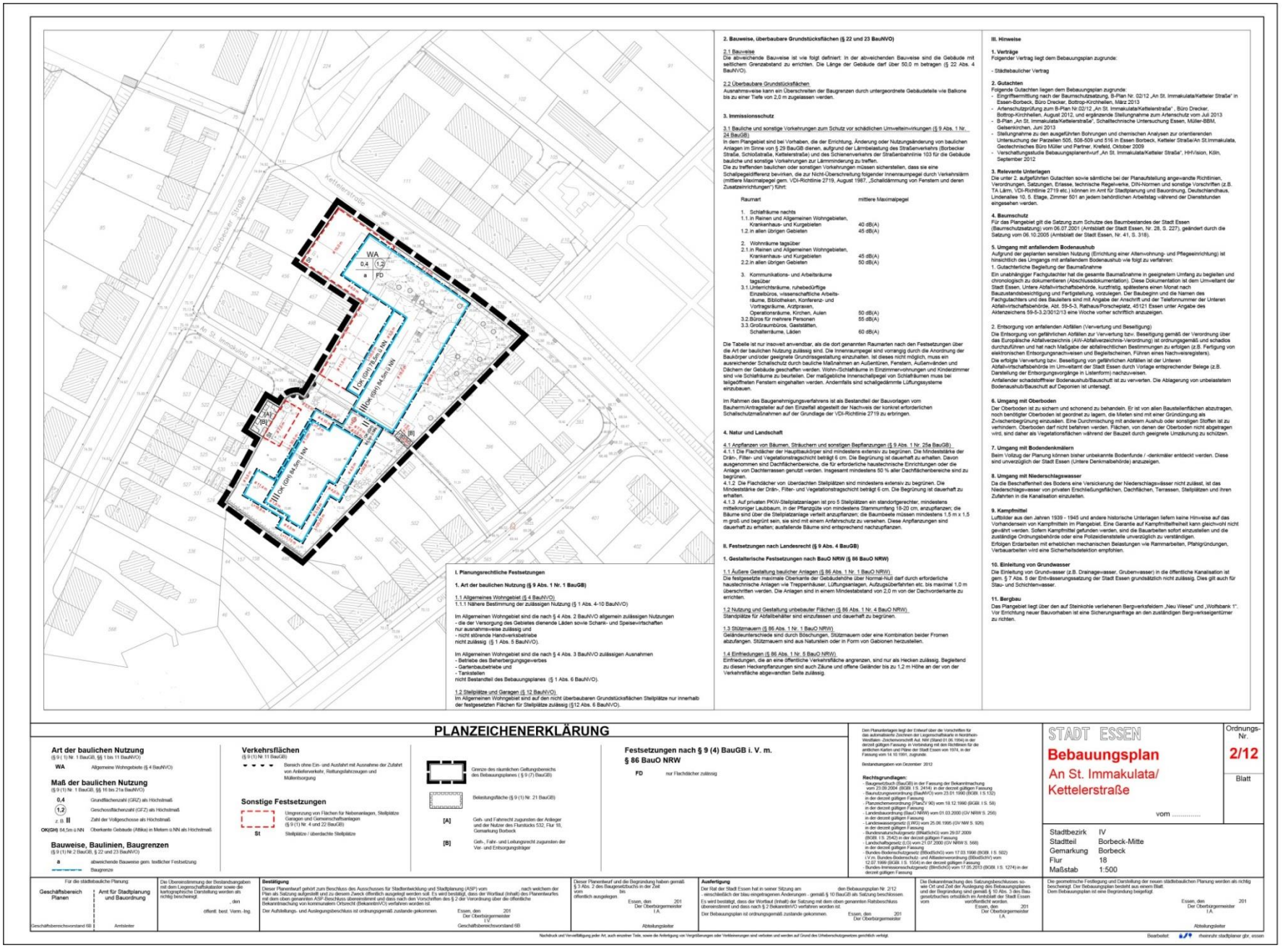
4.4.6 Legal character[4] of the urban plans in Essen

The German Bebauungsplan (which can be compared to the detailed plan/implementation plans in Iran) is mostly the plan used as a practical precise plan in urban planning. In figure 4.51 produced by the Essen municipality, all small details in the graphic plan on the left are based on the law as written on the right hand side of the plan. More over the written law is completely clear and has been adapted from the Federal Building Code (Baugesetzbuch). Any modification in the plan has to be according to law and cannot be subjective.

Apart from Bebauungsplan which has a strong legal character and is a kind of act in the German urban planning system, as shown previously in figure 4.44 each plan is also based on a law, a regulation or a written rule. The first row of the figure is the proof of the legal background of each urban plan which makes arbitrary changes impossible. This system can be a good example for Iranian urban plans which are produced by governmental organizations or private urban planning consulting companies and based on the ideas of the planners working on the projects. The urban regulations in Iran consist of a brief civil/urban engineering book and the approvals of Higher Council of Urban Planning and Agriculture. In Germany, however, there is written book for each aspect of the city such as environment, landscape or buildings which is the legal base for the relating plan that is being produced. BauGB, ROG, LPlG, BauGB, BauNVo are some examples of these laws.

[1]Verwaltungsgericht
[2]Oberverwaltungsgericht
[3]Oberstes Verwaltungsgericht oder Bundesverwaltungsgericht
[4] Rechtlicher Charakter

Figure 4.51: Bebaungsplan of Kettelerstrasse in Essen with law description base on the right side

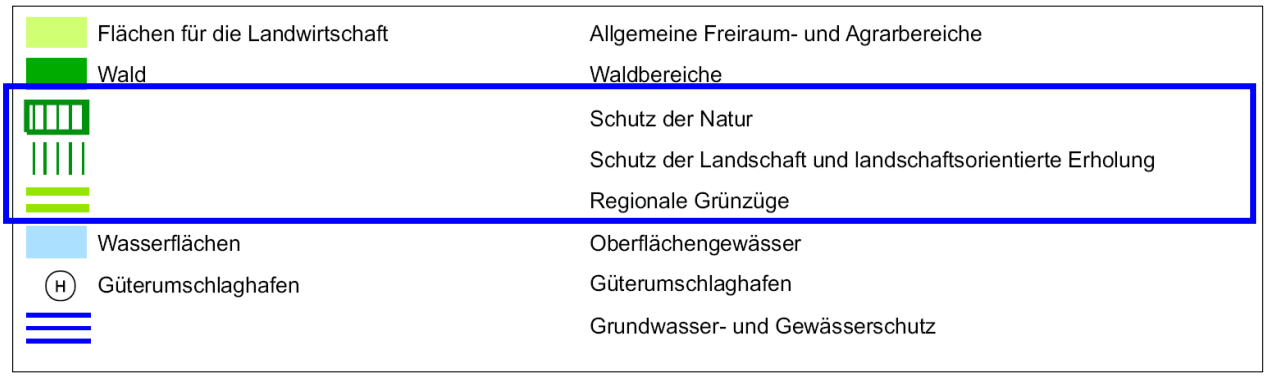


Source: Stadt Essen, 2013

4.4.7 Green field preservation in plans' contents

Protecting the green resources of the city of Essen is not guaranteed by a separated plan but is combined as a dominant concept in each plan produced by the municipality. Figure 4.52 shows a part of the legend of the Regional Land Use Plan with nature preservation, landscape and leisure protection and regional greenbelt as green concepts of the plan which have been extracted from the Landscape Plan and are exactly followed in the land use plan. This consistency between plans show that there are not only the compensation land pool and other green plans that try to keep the balance between built-up areas and green lands but also in a land use plan the guidelines are the same so that the whole system is on one track and follows one concept even if in different forms. Moreover, the status of green fields in the urban plans reflects that the term "urban" in German urban planning is not similar to the Iranian one. In Germany "urban" comprises both green and brown fields when in Iran an urban land use plan is mainly focused on built-up areas and does not necessarily have to follow the rules from environmental plans.

Figure 4.52: A part of the Regional Land Use Plan legend



Source: Stadt Essen, 2013

4.4.8 Environmental assessment[1] of the land use plan[2] in Essen

Environmental examination has also a strong legal background based on §15 (1) Landesplanungsgesetz, §5 Planverordnung zum Landesplanungsgesetz and § 2 (4) Baugesetzbuch. According to this background, this examination for the Land Use Plan in Essen is obliged. When the plan is provided, it will be sent to Environment Department[3] to be evaluated according to environmental criteria in Environment Report[4] containing:

Animals, plants,biologicaldiversity, landscape; ground; water; air; climate; person, health, population; culture

[1]Umweltprüfung
[2]Flächennutzungsplan
[3]Umweltsamt
[4]Umweltbericht

Figure 4.53: A part of the environmental assessment of the land use plan in Essen

Anlage Nr. 3 : Zusammenfasung Ergebnisse Einzeflächenprüfungen (Steckbriefe)

Stadt-Nr.	Fläche / Bereich	Festlegung / Darstellung	lfd. Km	Fläche in ha	Tiere, Pflanzen, Landschaft, biologische Vielfalt	Boden	Wasser	Luft	Klima	Mensch, Gesundheit, Bevölkerung	Kultur- und Sachgüter [1]	Gesamtbeurteilung	Bemerkungen
OB-18	Sportpark Stadion Niederrhein	So (ASB)		20,1	x	(A)	x	x	x	x	x	X	erheblich nachteilige Umweltauswirkungen, insbesondere durch Überplanung AFA, BSLE, Reg.Grünzug
OB-19	Mellinghofer Straße	Wo (ASB)		3,1	x	(A)	x			x		X	erheblich nachteilige Umweltauswirkungen, v.a. wegen Überplanung Freiraum, Bodenbelastungen, Immissionsschutz
OB-20	Wehrstraße	Wo (ASB)		3,2		(A) x	x			x		X	Konflikt v.a. mit Immissionsschutz u. Bodenbelastungen
OB-21	Im Sande	Wo (ASB)		4,5	x	(A)	x			x		X	erhebliche Auswirkungen v.a. wegen Überplanung Freiraum
OB-22	Holtener Feld	Was		23,3	x	(A) x	x						erhebliche Auswirkungen, teilweise positiv
OB-23	Gasometer	So (ASB)		5,3	x	(A) x	x	x	x	x	x	X	erheblich nachteilige Umweltauswirkungen, insbesondere durch Überplanung AFA, BSLE, Reg.Grünzug
120	Zwischenergebnis 25.05.2007		12,57	1.522	74	110	75	31	59	64	39	78	117
					(A) =	40							
					x =	51							
					(A) x =	19							

(A) = Altlast bzw. Altlastenverdachtsfläche
x = Auswirkung erheblich

Source: Stadt Essen, 2013

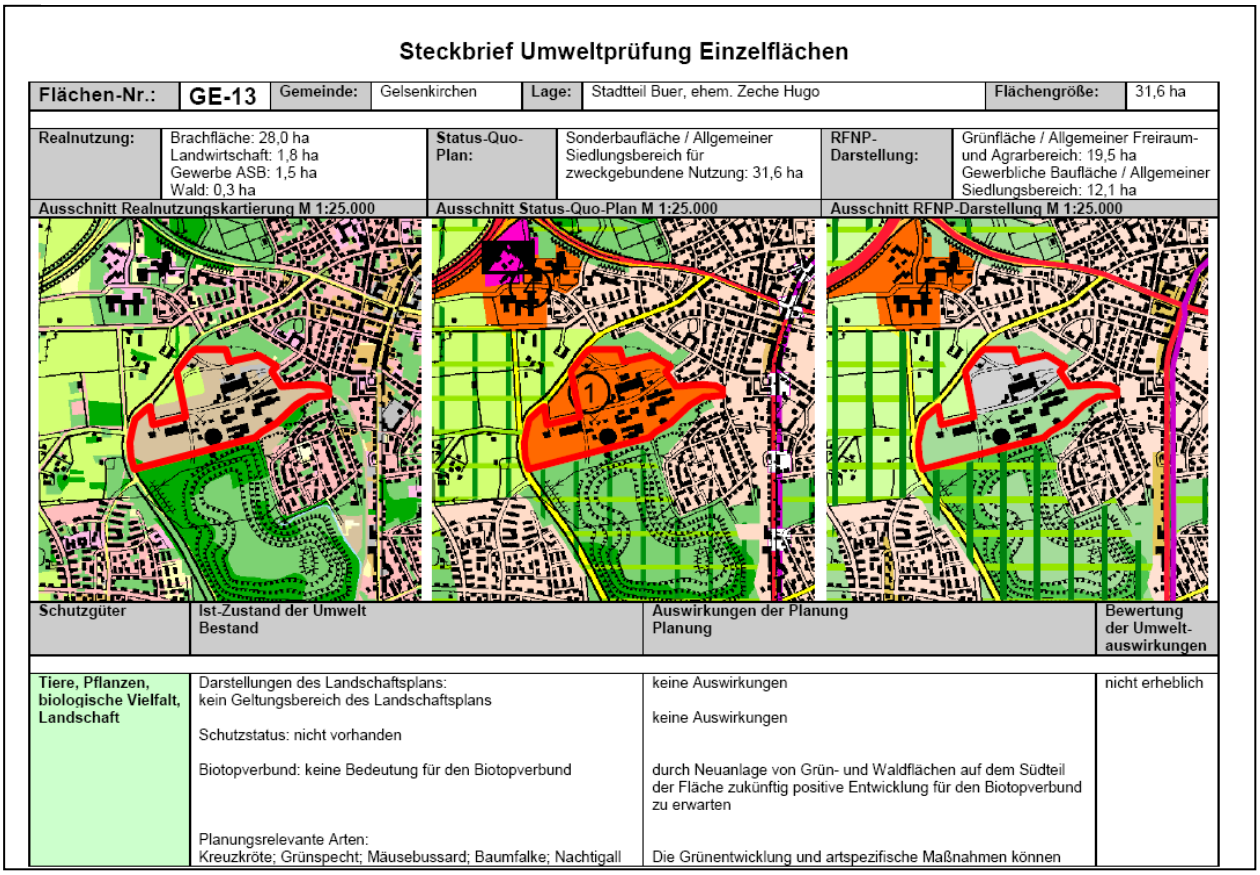
In Essen 120 parcels exhibiting the risk of damaging the environment in the new plan have been selected. For each of the selected parcels [1] a profile[2] has been generated and each case has been analyzed and assessed according to the above criteria. Figure 4.53 shows a part of a profile for the parcels in the above mentioned Regional Land Use Plan. The first column states the location of the parcel, in this case Oberhausen, the second one the exact street. The third column states the land use as described in the documents which can be dwellings (WO[3]), exceptional areas (SO[4]), general settlements (ABS[5]) or water protection area (Was[6]).The fourth and fifth columns show the extensions of the parcels and the rest of the columns try to describe the environmental characteristics/problems of the parcels based on the above environmental criteria. The total evaluation is summarized at the end and the last column explains if the final assessment is positive for the parcel or the parcel

[1]Einzelflächen
[2]Steckbrief
[3] Wohnungen
[4] Sonderbereich
[5] Allgemeinen Siedlungsbereich
[6] Wasserschutzgebiet

has failed and has environmental problems. Environmental problems are not just limited to plants and natural resources but the human being's health is physically, socially and culturally taken into consideration as well.

Figure 4.54 indicates the mapping process of a parcel profile. Three phases are being studied and analyzed: Actual Use[1], Status quo Plan, and Regional Land Use Plan. Among all 120 parcels 42 had no considerable negative impact on the environment but 78 parcels failed. Therefore the plan had to be altered to fulfill the environment factors. The regional plan is not legally approved if it has not passed the environmental assessment. This makes the urban planners consider all environmental conditions while producing urban plans.

Figure 4.54: Parcel's Profile in environmental assessment of Regional Land Use Plan



Steckbrief Umweltprüfung Einzelflächen

Flächen-Nr.:	GE-13	Gemeinde:	Gelsenkirchen	Lage:	Stadtteil Buer, ehem. Zeche Hugo	Flächengröße:	31,6 ha

Realnutzung:	Brachfläche: 28,0 ha Landwirtschaft: 1,8 ha Gewerbe ASB: 1,5 ha Wald: 0,3 ha	Status-Quo-Plan:	Sonderbaufläche / Allgemeiner Siedlungsbereich für zweckgebundene Nutzung: 31,6 ha	RFNP-Darstellung:	Grünfläche / Allgemeiner Freiraum- und Agrarbereich: 19,5 ha Gewerbliche Baufläche / Allgemeiner Siedlungsbereich: 12,1 ha

Ausschnitt Realnutzungskartierung M 1:25.000 | Ausschnitt Status-Quo-Plan M 1:25.000 | Ausschnitt RFNP-Darstellung M 1:25.000

Schutzgüter	Ist-Zustand der Umwelt Bestand	Auswirkungen der Planung Planung	Bewertung der Umwelt-auswirkungen
Tiere, Pflanzen, biologische Vielfalt, Landschaft	Darstellungen des Landschaftsplans: kein Geltungsbereich des Landschaftsplans Schutzstatus: nicht vorhanden Biotopverbund: keine Bedeutung für den Biotopverbund Planungsrelevante Arten: Kreuzkröte; Grünspecht; Mäusebussard; Baumfalke; Nachtigall	keine Auswirkungen keine Auswirkungen durch Neuanlage von Grün- und Waldflächen auf dem Südteil der Fläche zukünftig positive Entwicklung für den Biotopverbund zu erwarten Die Grünentwicklung und artspezifische Maßnahmen können	nicht erheblich

Source: Stadt Essen. 2013

4.4.9 Tree preservation[2]

Each tree in Essen is preserved according to its characteristics (type, size, age, root qualification) and based onthe Tree Preservation regulation dated 15.10.2005.Which types of trees are to be protected and regained depend on the individual regulations of the cities. This protection reflects green preservation from higher scales to the small one of a tree.

4.4.10 Theallotment gardening[3] concept in Essen

The history of the allotment gardens in Germany is closely connected to the period of industrialization and urbanization in Europe during the 19th century when a large number of people migrated from the rural areas into the cities to find employment and a better life. Very often, these families were living under extremely poor

[1]Realnutzung

[2]Baumschutzung

[3]kleingarden

conditions suffering from inappropriate housing, malnutrition and other forms of social neglect. To improve their overall situation and to allow them to grow their own food, the city administrations, the churches or their employers provided open spaces for garden purposes. These were initially called the "gardens of the poor".

The idea of organized allotment gardening reached a first peak after 1864, when the so-called "Schreber Movement" started in the city of Leipzig in Saxony. A public initiative decided to lease areas within the city, with the purpose to enable children to play in a healthy environment, and in harmony with nature. Later on, these areas included actual gardens for children, but soon adults tended towards taking over and cultivating these gardens.

The aspect of food security provided by allotment gardens became particularly evident during World Wars I and II. The socio-economic situation was very miserable, particularly as the nutritional status of urban residents was concerned. Many cities were isolated from their rural hinterlands and agricultural products did not reach the city markets anymore or were sold at very high prices on the black markets. Consequently, food production within the city, especially fruit and vegetable production in home gardens and allotment gardens, became essential for survival. The importance of allotment gardens for food security was so obvious that in 1919, one year after the end of World War I, the first legislation for allotment gardening in Germany was passed. The so-called "Small Garden and Small-Rent Land Law", provided security in land tenure and fixed leasing fees. In 1983, this law was amended by the "Federal Allotment Gardens Act".[1]

Figure 4.55: Allotment garden in Germany

Source: www.wikipedia.com

These gardens' preservation rules are very strict so that there would not be any opportunity for land speculation or any possibility of city development on them. According to this regulation in Essen an only 24 m^2 building can be built in the garden whereas 40% for flower or planting beds are required and 60% for grass are mandatory. This control/surveillance tool tries to make preservation functional and is a kind of small scale preservation. As shown in figure 4.55 and explained above, the most important qualification of these gardens is the fact that there are not only regulations for buildings but all the details of green space characteristics have been legally and strictly defined as well. There is also a preservation plan within the context of this plan. The second point is that these gardens are not only green spaces but they are also a signature of history of the difficult days the German nations went through to build up their lives again. Thus they have an extra value which stems from history. This situation can be compared with Tehran gardens which are the socio-cultural heritage of the first residents of Tehran. They all have the urban memories of decades which have been erased by modernism and by high-rises

[1]Bundeskleingartengesetz

in the last two decades. In both cases there are additional values rather than just preserving green lands for a better urban life, and these values have more to be taken into consideration.

4.4.11 Conclusions

Essen can be a representative of the German urban management system and is a good example to see how exact the urban laws can work in practice. The hierarchical system is the essence of urban plans, management structure and court system, and this is strictly followed in cities. Germany has a legal base for all its urban plans which makes the boundaries and rules clear and therefore the infraction can be relatively prevented; but on the other hand the density of laws makes it difficult for ordinary people to perceive the concept of the rules and to participate in managing the city. Nevertheless, the existence of courts and the right that people can complain about the enacted rules and projects in their cityallows a strong participation of citizens in urban management.

As far as environmental issues, Germany has tried a lot in recent years not only to launch green plans like WEN and BEN in Essen but also to embed the green concept of urban planning into the urban plans such as the compulsory environmental assessment in the regional Land Use plan in Essen or the preservation of different green fields categories in the regional Land Use Plan.

The concept of Ersatzflächenpool is very close to Transferable Development Rights[1] which can successfully be applied to preserve valuable lands in any kind of cities. As this process has positively been tested in practice, it makes it more definite that this approach might be useful in the case of Iran as well but this requires a clear ownership and tax information system in Iran which still sees many obstacles to be achieved.

One of the reasons of the success in green lands preservation in Germany is that the board which decides for a plans is different and totally separated from the commission or organization which approves and enacts them. Therefore the plan has to go through two filters to step into implementation phase. The other fact is that any plan with any character has to be consistent with other plans in the city since they all belong to one city. Thus the environmental rules in the Landscape Plan can be found in the legend of Regional Land Use Plan and it is like a long track which all the plans are driving on but in different aspects of the city. The principal point is that they all follow one approach as they all are on one track.

[1] TDR

4.5 Preservation experiences and system in Iran

In this part of the research the green lands' preservation system in Iran will be explained by describing the whole urban management structure, preservation body management, the preservation acts, laws and regulations and as well as the current preservation projects or plans. It is tried to find how this system functions and how this works and to what extent it can influence the green lands in cities. The objective is to extract the urban management criteria which can optimize the system in a way to obtain the best preservation framework suitable for Iran.

4.5.1 The urban management system in Iran

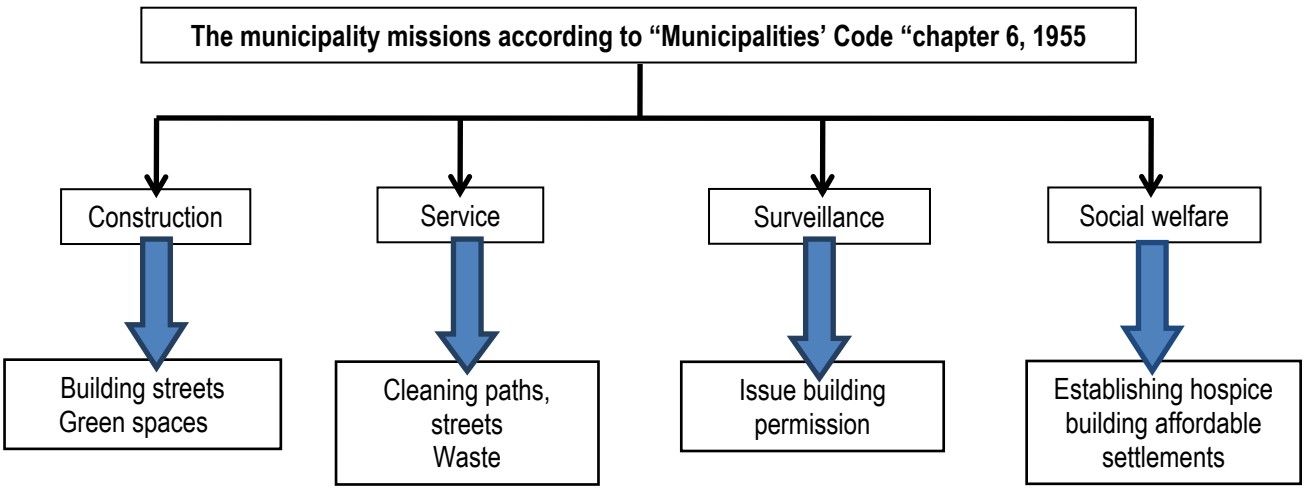
At the beginning there will be a brief introduction to urban management in Iran so that the next section regarding preservation management can better be perceived. Iranian urban management has been inspired by the American model. "There are four urban management models in the US- system: The mayor-council Form, the council-manager form, the commission form and the open and representative Town meeting.

In the mayor- council form the mayor is elected directly by the people, while in the council-manager form the manager is selected among commissioners by the council (Barakpour and Asadie, 2011, p.154)." The Iranian system floats somewhere between the first form and the second form; the mayor is elected by a commission for 4 years while the commissioners are elected by the people. The mayor cannot simultaneously be a member of the city commission and the council and the city council can fire the mayor. "Iran history shows that before the constitutional revolution of 1905-1907 which led to the establishment of Persian parliament, people had no participation in urban management, and the political system was strictly centralized. City managers were directly selected by the king. The municipality Act was passed with 108 articles for the first time after the establishment of the parliament, and according to this act the mayor was to be elected by the city council. But this Act has hardly been implemented in reality. After President Khatami, the reformist president elected in 1997, the power of these councils increased but the complete form still needs time (Saeidnia, 2013, p.65)."

The municipal Council or the city council or the City Commission has the municipal legislative power. The responsibilities include electing the mayor, approving the plans for the city, approving the local legislation proposed by the mayor, approving the budget and municipal rates. The commissioners are elected directly by people for a period of 4 years.

The municipality has been defined in Iran Law as follows: "A public, non-governmental organization with a legal-independent character which functions under the surveillance of the City Commission (chosen by people) and government (through Interior Ministry) with the missions according to Municipalities' Code, chapter 6, 1955". Figure 4.56 shows the municipalities' responsibilities in Iran.

Figure 4.56: Missions of the municipality according to law in Iran



Source: After Saeidnia, 2013, p.53

“According to law the municipality has 53 responsibilities in the city but in reality just 39.6 % of them are accomplished by the municipality. The rest is done by cooperation or individually by other organizations and private sections. Nowadays the municipality’s missions have been limited to street construction and public parks (Saeidnia, 2013, p.55).” When it cannot fulfill its duties which are very crucial for the citizens, a change in law would be a good suggestion so that the municipality and its responsibilities could be clearly defined legally. The responsibilities and tasks of each department in the city have to be clear and exactly defined by law or in a book.

The duties of the municipality relating green lands which are called “green activities” in this research have either positive or negative impacts on urban green spaces. According to Article 55 of “The municipality Code” approved in 1955 these activities can be summarized as follows; create and develop public gardens, issue building permission, cooperation with the Culture Ministry to preserve valuable monuments, control polluting factories and machines to prevent air pollution: close/move them outside of the city.

The second task gives the full power to the municipality to give permission for construction. At the same time and according to the first task, the municipality is responsible for developing gardens, and preserving green lands is partially in its hand. These two responsibilities are in contrast with each other because an organization can hardly have the approach of developing buildings and gardens simultaneously; especially in developing countries developing a land is in most cases followed by destructing a garden, and there is more economic benefit in constructing a building than in developing a garden.

Tehran has 22 divisions (or regions) and each has its own municipality with a significant responsibility of supervising the implementation of "Master" and "Detailed" Plans. The municipality of each region has the following sections; the Department of IT and Planning, Department of Urban Planning, Department of Civil, Department of Traffic, Department of Urban Services Green Area and Department of Disaster Management.

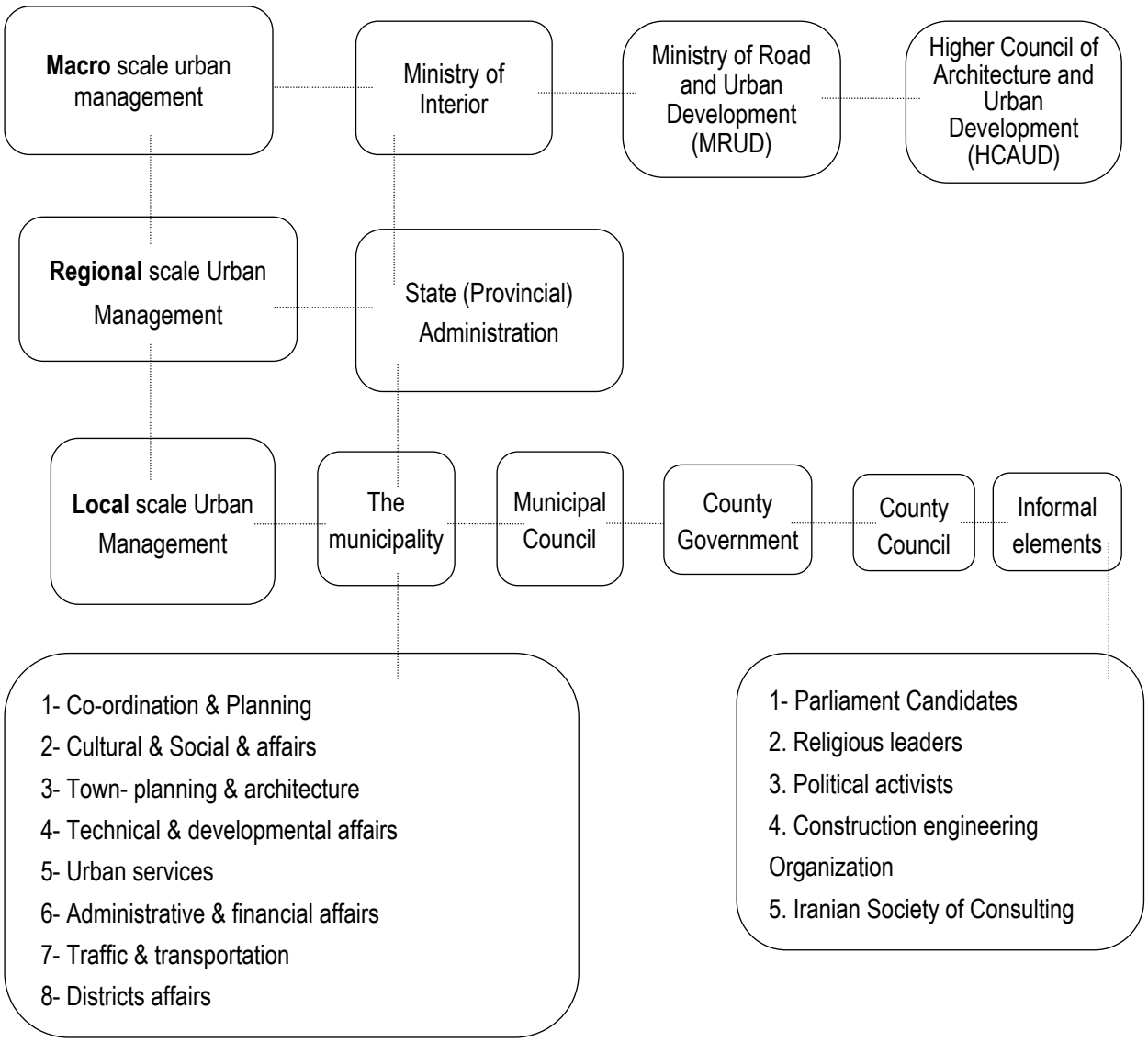
Therefore municipalities in Iran are local organizations, not an independent local authorization and this concept has made lots of problems for preservation plans and budget system which will be discussed later in conclusions. On the other hand urban management is not conducted by municipalities and as a result there are too many unorganized and parallel departments trying to solve Tehran problems such as green field preservation. For different city scales, different organizations are responsible:

From Top to bottom macro-scale urban management is being carried out by the Ministry of Interior which has the task to survey and approve the changes in the whole structure. On the next scale there is the regional urban management which is the duty of the Ministry of Road and Urban Development[1] that sets urban regulations, surveys the implementation of the Detailed Plans and implements civil urban plans. Thus there are overlapping tasks and an unclear structure, as implementation, enacting and surveillance are three different kinds of responsibilities which cannot be conducted by one organization. At the lowest level, local scale urban management is conducted by the Higher Council of Architecture and Urban Development[2] which is responsible of supervising urban activities and coordinates urban plans. Although these responsibilities have been given to this council, CC5 emerges with totally other tasks as a part of the council. The urban management system in Tehran (Figure 4.57) shows the hierarchy which has also been successful in the previous examples. But whereas there the different levels should have strong connections with each other so that all the tasks can be clearly defined and categorized. Yet in the Iranian system there are parallel duties accomplished on different levels and a weak communication exists. In addition, as shown in figure 4.57, the regional scale is very thick which causes a gap between the upper level and the local one.

The Ministry of Interior is the highest and eldest organization in the urban management system. Any modification of the municipality structure, any reviewing and passing of urban plans such as the master plans are in the responsibilities of this ministry. Relating municipalities, the Ministry of Interior is a surveillance body which monitors how they perform and fulfill their duties (Saeidnia, 2013, p.74).” Therefore, this organization has more focused tasks concerning urban management/municipalities and its main character is surveillance.

[1] MRUD
[2] HCAUD

Figure 4.57: Iran urban planning system



Source: Author derived from Saeidnia, 2013, p.73-79

However, financial problems have always been a debate between municipalities and the Ministry of Interior. "Couples of years ago the Ministry of Interior used to support the municipalities economically but with the change in government policy towards municipalities and the approach of the municipality independency, these helps decreased till today that most of his supports are just limited to certain urban civil plans which are essential for urban security and transportation (Saeidnia, 2013, p.74)."

Since 2011, the Ministry of Road and Urban Development in Tehran is the combination of two different organizations, the Ministry of Housing and Urban Development[1] and the Ministry of Roads and Transportation. The responsibilities of this ministry concerning urban management are to set urban regulations and standards, to survey the different steps of the implementation of Urban Detailed Plans and to implement of civil plans (Saeidnia, 2013, p.76)." Consequently, three various types of responsibilities which have been taken from different fields (legislation, surveillance and implementation) are given to one single organization. This can cause conflicts between this ministry and other organizations responsible for these tasks and weakens the clear boundaries of duties and the explicit management structure.

[1] MHUD

The Ministry of Road and Urban Development: Set urban regulations; survey the implementation of detailed plans, implementation of civil urban plans

Legislative and executive responsibilities can be conducted by one organization but it cannot do surveys on the implemented plans based on the rules it itself had enacted!

The MRUD in Tehran has the crucial role of designing the city master plans and comprises the following sections: Acoustic; Architecture, Housing and Building Systems; Building Installation Department; Concrete Technology Department; Economic and Social Research Department; Environmental, Energy Design Department and Geotechnical Department. The existence of so many departments inside one organization makes the structure even more complex and the allocation of the responsibilities harder and unclear. There is no necessity of these departments inside the ministry when the same organization or organizations with similar tasks exist outside of the ministry in bigger scale.

The Higher Council of Architecture and Urban Development (Commission Code 5[1]) is of importance because the CC5 which is part of its structure. CC5 is the most important body in green lands' preservation management and is to survey and modify Detailed Plans and Comprehensive Plans, to survey and approve urban Conceptual and Local Plans, to survey and approve urban regions, to change urban patterns and to survey and supervise the implementation of approved urban area per capita in the city and to survey urban plans implementations.

The importance of this commission is due to the first responsibility, i.e. to modify urban plans including land use conversion; changing the green land uses (garden and farmland) to non-green can be implemented by its permission. The second important characteristic of this commission is its member structure that includes representatives of the Urbanism and Housing Deputy (recently changed to the Ministry of Road and Urban development) prime minister, Deputy Interior minister, Environment Protection Agency representatives, Head of Islamic Council of Tehran, Head of Construction Engineering Organization, Tehran municipality, Deputy Agriculture minister and Deputy Energy minister.

In this structure the municipality is the head of the commission and consequently has a high power while it simultaneously applies for land use conversions for citizen developers in Tehran. This contradiction prepares a suitable ground for changing the green land uses to non-green when the municipality has the intention to develop and support real estate investors or builders. In context, the Construction Engineering Organization has the technical engineering knowledge about technical urbanization rules and enacts national construction laws/standards but its head does not have the right to vote in the commission meetings and to take part in its decisions.

✓ *The Ministry of Road and Urban Development*: Set urban regulations, survey the implementation of detailed plans, implementation of civil urban plans

✓ *The High Council of Architecture and Urban Development*: Survey/modify urban plans and their implementations

Parallel, unclear and repetitive responsibilities: more work, more energy and less effective

The commission claims that the land use conversions are according to approved land use per capita fulfillment but when each conversion is approved in the approval meetings, there is no sign of taking land use per capita in each region into consideration. In order to map the results of this commission, each parcel number must be found

[1] CC5

in Tehran Cadastral map. In each commission meeting, the numbers of the parcels are written according to Cadastral map but the access to this map is almost impossible due to residents' privacy reasons.

The deputy of the HCAUD claims that the land uses of the new approved detailed plans are flexible. Each parcel approved land use in Detailed Plan is promulgated to the owner by the municipality as a 3-digit code and can be altered. Although the land uses and building densities have been approved, the owner has the right to request for another land use which is permitted in the zone, if he has an objection against the land use and believes that this land use is not suitable for him. This gives the neighborhood a variety of land uses, not fixed but changeable.

This can be considered as people participation in urban planning but, on the other hand, people cannot be considered as urban planners being aware of what is suitable for their city as a whole. Each person intends to receive the highest profit from the property he owns and this is not possible with low-density residential or green land uses. Therefore, in a few years the city will go through another urban planning crisis in which the municipality will blame it on "The Will of people". In the last decades, this land use conversion has been claimed to be impossible, but the result was a huge number of garden conversions to non-garden land enacted by commission 5 with fine compensations received by the municipality. Currently all the processes have been organized legally and the way is open for anyone to participate. As a consequence, the outcome will be a city worse than it had been in the past.

In some developed countries this method may function well. However, in a developing city like Tehran with complicated urban issues and the need of a powerful control on land use change as well, there should be more professional urban planners being involved in solving urban problems and improving the quality of life by approving the appropriate urban land uses in the different city regions. Even the best of people's knowledge will not be able to solve the multidimensional complications in the urban situation of Tehran. If there were a written act book to which people could refer and apply for land use conversions according to urban rules, this kind of participation could be considered as the situation described for Essen, Germany (Baugesetzbuch).

The mayor of Tehran has executive power in the city. His executive work is in the following areas: Legal, council and parliamentary affairs; Social and cultural; Traffic and transportation; Urban services; Planning and coordination; Financial and administrative; Urban planning and architecture; Legal, the city council and parliament; Districts; Tech and development.

Each of the 22 Tehran regions has its own administrative body and its head is the region mayor. Therefore, Tehran has 22 region mayors who report their activities to the mayor of metropolitan Tehran. The previous Mayor of Tehran was Karbaschi who was one of the most powerful mayors in changing the image of Tehran in both negative and positive ways. He has been the driving force for many new modernization efforts. He was known for having bulldozed apartment buildings and office buildings built without city approval, removed revolutionary graffiti from walls, planted thousands of trees, banned much of the private traffic in central Tehran and opened more than a hundred parks. Karbaschi also angered bazaar merchants by raising taxes and contributing to the city's soaring real estate prices. These wide spread activities indicate how sweeping the power of the mayor can be in the Tehran urban management system. In 1998 he has been convicted of corruption and misuse of funds and began serving a two-year sentence in May 1999.

Mayor Gholam Hossein Karbaschi's controversial transformation of the city in the 1990s was based on mobilizing a speculative and entrepreneurial urban middle class, which had emerged after the war and had accumulated its wealth primarily through speculation in urban real estate and construction. Unable to count on the central government to bail it out, the virtually bankrupt the municipality decided that financing for Tehran's urban renewal should come from 'public participation', a euphemism for a pact between the municipality and the speculative capital floating in the shadow economy. Extracting fees from developers in exchange for zoning exemptions, the municipality collected an estimated $6 billion from 1990 to 1998. Most of the revenue was generated by the 'sale of density' or the privatization of the urban skyline, which favored developers by allowing them to subdivide plots and build high-rises well above the permitted norm, resulting in a substantial increase in Tehran's 'vertical density' (Samhouri, 2010, p.2)."

Since the city council got its power after President Khatami (reformist), the mayor in Tehran has regained the previous strong legislative and executive power. It can be claimed that he is the self decision making body for the whole city of Tehran.

4.5.2 Greenfield preservation management in Iran

In this section the urban management organizations responsible for green field preservation in Iran, especially Tehran will be reviewed, studied and analyzed. The goal is to have detailed information about how the system works in Iran and how it can be improved by conducting a comparison study between Tehran and other experiences described in the current chapter. Accordingly the departments/organizations which have a duty related to green lands preservation will be described according to their duties.

The municipality: According to Article 55 of "the municipality Code" approved in 1955 the municipality has different duties as explained before; concerning green spaces (Green duties) it could be claimed that its main duty is the 'green space planning management'. There are councils and departments inside each municipality which are more specialized in preservation, the most important ones are the Parks and Green Spaces Organization [1] and the Deputy of Architecture and Urban Planning.

Bureau of Urban Services (Parks and Green Spaces Organization): Green spaces planning, management and implementation are the responsibilities of the municipality, but in big municipalities there is a section of Bureau of Urban Services named "Parks and Green Spaces Organization". In each municipality this office is specialized in preserving green spaces and expanding them and in enhancing the quality of the existing green spaces. In cities with less than 200 thousand inhabitants this responsibility is fulfilled by the Bureau of Urban Services itself. Due to many conflicts and interferences between the municipality and this Bureau, the responsibilities of this Bureau have been transferred to the city council in 2007. The responsibilities of "Parks and Green Space Organization" are based on a legal basis called "Preservation and Expansion of Green Spaces" act or named 'Green Act' in the current research. According to this act this organization has duties such as setting and receiving the preservation and expansion taxes, surveying the implementation as well as producing GIS maps and data banks for gardens and trees (Arjmand, 2010, p.7). A quick review of the duties mentioned above indicates a combination of very different sorts of duties for one organization. Working with taxes represents financial duty to the organization while working with GIS needs technical staff and surveillance is completely another kind of responsibility. This mixture of inconsistent duties in one organization may end in malfunction. Specialization in one task and distributing different sorts of duties among different organizations can lead to a more organized system with optimal function. Especially the monetary tasks should be completely separated from other tasks since a responsible organization should not be interfered in other sections and accordingly consider any priority for its own section from which it may economically benefit.

Deputy of Architecture and Urban Planning: "This deputy is part of the municipality and is responsible for the implementation of the approved plans (including preservation plans) and has to preserve the gardens and agricultural lands according to article Nr.14 of the "Urban Land" Act" (Arjmand, 2010, p.8). Classifying preservation plans with others in the same category decrease the concentration on the preservation goal. A separate organization with the unique task of preservation could operate more efficiently in implementing preservation plans. Due to the importance and sensitive essence of preservation plans, they should be approved in a way different from other urban plans.

The City Councils are local councils which are elected by public voting in all cities throughout Iran. Council members in each city or village are elected by direct public voting for a 4-year term. According to article 7 of the Iranian Constitution, these local councils, together with the Parliament, are decision-making and administrative organs of the State. The councils are in charge of electing mayors, supervising the activities of municipalities, studying the social, cultural, educational, health, economic, and welfare requirements of their constituencies, planning and coordinating the national participation in the implementation of social, economic,

[1] PGSO

constructive, cultural, and educational and other welfare affairs. The city council is divided into the Commission of Development and Civil[1], the Commission of Culture and Society and the Commission of Planning and Budget. The CDC has two different sections which are related to green fields' preservation, the Secretariat of Garden Commission and the Environment Committee.

- ✓ The Ministry of Interior: survey on municipalities, how they fulfill their duties
- ✓ The City Council: Supervising the activities of municipalities

⇩

Parallel and repetitive responsibilities: more work, more energy and less effective execution of the legislations and consequently weak inspection on municipalities

The Secretariat of Garden Commission is responsible for recognizing the garden status and decides if, according to standards a parcel is a garden. It also solves problems between the owners and the municipality and decisions as far as cutting trees or transferring them. According to the new revision of the Green Act, the city council is responsible for distinguishing the gardens, but the final decision is made by the Secretariat of Garden Commission. The very first garden recognition is a task of the municipality, a member of the city council and a representative from Iran Department of Environment (Bafte-e-Shahr, 2009, p.1-41 quoted after Arjmand, 2010).

As described above, a clear borderline between the responsibilities and the person responsible for the task does not exist and a couple of organizations and departments are in the process of reviewing the documents and decide whether or not a parcel is a garden. If this is a process of decisions including different departments, there is no sequence or order of where, what and by whom should be accomplished in this chain and what is given to the next ring of the chain process.

It can also be concluded from the above that recognizing a parcel as a garden which is a very essential task in the preservation problems is distributed among three different but weekly connected management bodies. The city council which is based on the new version of "Green Act" and is the only organization responsible for garden status recognition, the Secretariat of Garden Commission which suggests regulations concerning preservation, and the municipality which does the very first recognition of garden status.

Thus, even if the main responsible body according to law is the city council, the Secretariat of Garden Commission has still a strong influence on the decisions and currently there are challenges between these organizations which make the whole system quite inefficient.

Distinguishing the Gardens: City Council
The very first garden recognition: The municipality
The final decision: The Secretariat of Garden Commission

⇩

A complicated decision structure to submit if a parcel is a garden or not, no coherence

The Environment Committee is also under the surveillance of the CDC. Its defined goal is to present sustainable environmental patterns and combine them with the municipality plans to achieve a successful environmental model based on integrated management of all Tehran. The committee is responsible for amending environmental plans or plans having impact on environment, for producing and developing environmental plans to be presented to the Commission of Civil, for evaluating the environmental function of the municipality and also for implementing and evaluating the efficiency of The city council approvals in the field of green spaces, gardens and open spaces (Arjmand 2010, p.9). As explained above, the Deputy of Architecture and Urban Planning is responsible for the implementation of the approved plans including preservation plans whereas almost all of the environmental affairs are in the duty of the Environment Committee. Concentration of a task with the unique character of

[1] CDC

“environmental” could make the system more organized while separating one certain task between different departments decrease the efficiency of the whole process.

The second point that can be questioned in this system is the responsibilities of the Environment Committee as a part of the city council. This committee is a part of CDC which itself is a part of the city council. Thus evaluating the city council approvals cannot end up in effective results. The surveillance body should be outside the system of the city council should not be a member or a sub-division of the council. Only in this case the judgments can be fair and beneficial for the whole city and residents.

The Ministry of Housing and Urban Development which has recently been turned into the Ministry of Road and Urban Development is crucial for green space preservation in Tehran because it is a member of CC5 and also a member of the Higher Council of Architecture and Urban Development. These two have great influence on preserving gardens and agricultural lands in Iran. Within the MHUD there are two important organizations concerning green fields, i.e. the National Land and Housing Organization and also the High Council of Urban Planning and Architecture.

National Land and Housing Organization has been established on the basis of the “Urban Lands” act approved by parliament in 1981 for 5 years according to Leader Imam Khomeini’s will. The detailed explanation about this act will be given in the next section.

The High Council of Urban Planning and Architecture with CC5 is also a part of MHUD. Any land use change from garden to non-garden and from agriculture to non-agriculture has to be approved in this council; therefore it can be considered as the most crucial management body in land use conversion, especially for the gardens and agricultural lands of Tehran. The manager of the Commission is the Mayor and the head of the Commission is appointed by the Mayor and suggested by the Deputy of Urban Planning and Architecture. The detailed explanation of this Commission has been given in the last section.

In Ministry of Interior, the Organization of urban and the rural municipalities is responsible for planning and financial support to increase green area per capita of Tehran; it cooperates with municipalities and the Ministry of Agriculture. The Commission Code 7 or the Garden Commission which has all the documents on gardens and their characteristics in Tehran comprises representatives from this ministry, Iran Department of Environment and the MHUD.

Ministry of Agriculture: The goal of this ministry is to enhance agriculture and the related education and is a member of the CC5 and the High Council of Architecture and the Urban Development. Preservation of the green spaces inside the cities is within the responsibilities of the municipality whereas according to the Preservation of Farmlands and Gardens’ Land uses act passed in 1995 for the conservation of green lands in suburbs and city boundaries this ministry is responsible. This split of responsibility due to the geographical characteristics causes a gap within the regional green network in metropolitan Tehran. The idea of considering all the green spaces as a connected network can be achieved if they are all under the surveillance of one organization or if the organizations have a strong connection which is not true for the two mentioned above.

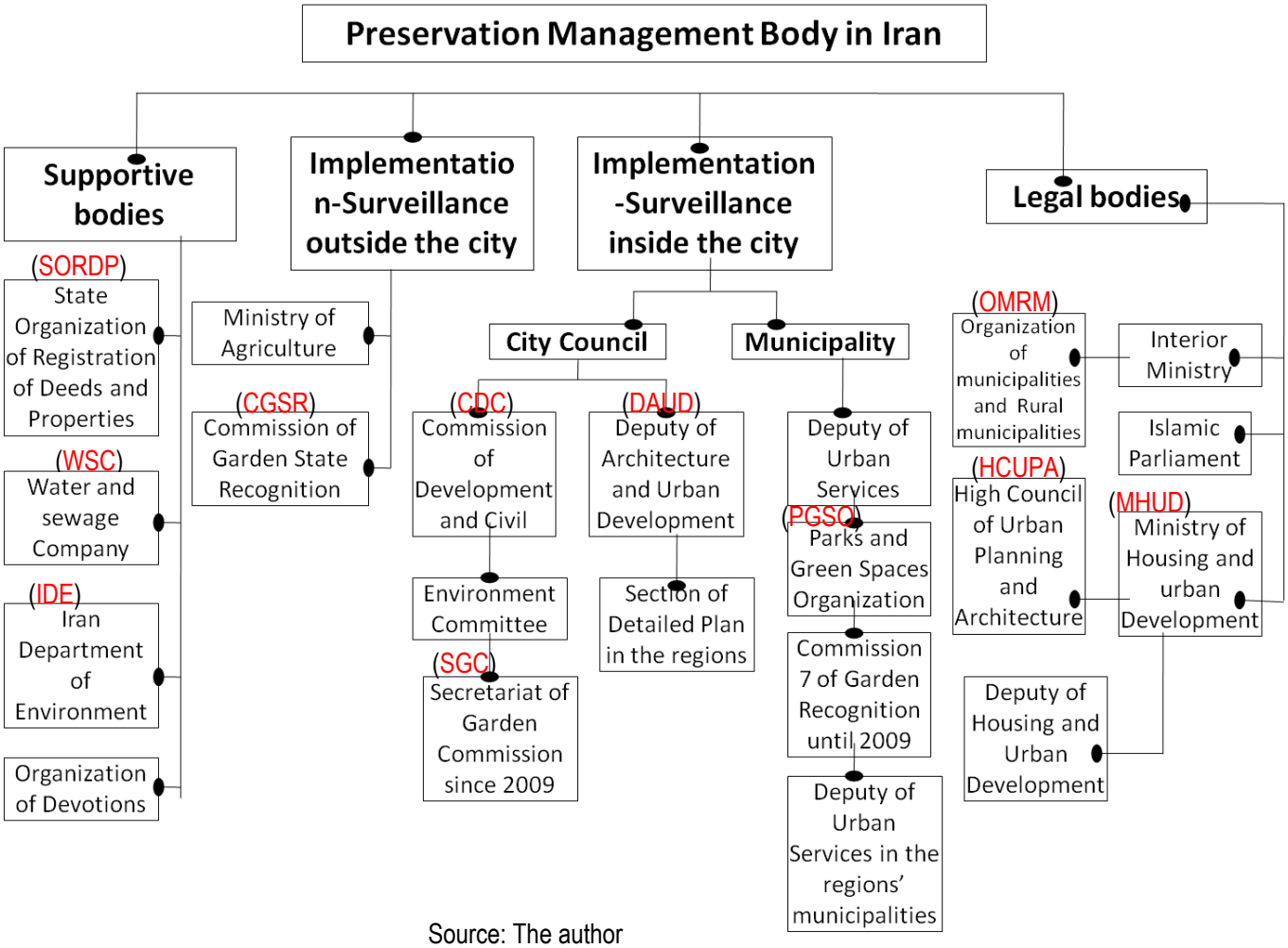
After the United Nations Conference on Human Environment in 1972 and the approval of the “Environment Preservation and Improvement“ Act, Iran Department of Environment has been established to implement the article N.50 in the Iran constitution which is to preserve the environment, to prevent any destructive pollution of the environment and to preserve the species diversity. The responsibility of this department comprises the survey of environmental pollutants, the optimal site selection of huge industrial units and agricultural centers according to environmental standards, the recognition of regions with valuable species, the development of environmental standards to manage water, soil and air resources, the increase of the knowledge about the environmental, and the prevention of the pollutants that might endanger the environmental recourses.

Although this department is responsible for the environment, as far as garden preservation is concerned the only mission it has is to send representatives into the HCAUD and into the Commissions Code 5 and Code 7. Figure 4.58 shows the management structure in Iran urban planning.

Iran Department of Environment: preserve environment, survey of environmental pollutants
The Environment Committee in the Commission of Development and Civil: present sustainable environmental patterns, evaluating the environmental function of the municipality…

Investment on organizations with the same approach. No coherence/connection between the organizations with similar tasks.

Figure 4.58: Iran urban Planning System



Source: The author

4.5.3 Laws, regulations and acts related to greenfield preservation in Iran

In this section different laws and acts concerning green preservation in Iran will be reviewed. The goal is to find the missing regulations, parallel acts or contrasts between different regulations and departments responsible for them. At the end the problems in the legal system will be summarized and the reasons that many gardens and agricultural lands have been legally destroyed will be tried to find out.

"The 1980 Preserve and Expand of Green Space Act" is the main act responsible for preserving green fields in the cities. Its goal is written in the first article as "preserve and expand green spaces and trees". The municipality is responsible for developing executive regulations concerning this act which will further be approved in the city council. The Executive regulation of Article 1 has been approved in 1994 by the Ministry of Interior which has the mission to assure that all municipality and the city councils rules are compatible with each other. Since the

reinforcement of the city council in 1998, all the regulations of Article 1 must be developed anew in each city and have to be approved by the city council; The Tehran city council amended and completed the regulations in 2004. Although the Act itself was enacted in 1980, it took so many years to make it a practical act in the city of Tehran which is legally implemented and has to be followed. However, it was in this period that Tehran lost many of its green spaces due to the lack of the clear written action plan/law.

Green Act: Preserve and enhance green spaces: enacted in 1980
Reinforcement of the City Council in 1998: Tehran amended and completed the regulations in 2004

⇩

A long process for the legislation to have the full executive power: Weak legal base for green preservation

The crucial articles of this act and its amendments concerning the current research are discussed below:

The Article 7 of the Code of Practice of the Amendment (2009) of the Green Act of 1980 is the basis of the Commission Code 7 or the Garden Commission which is responsible for the garden status recognition according to following criteria: Geographical situation, natural flora, documents' archives, regulations in the Article Nr.7 of the Green Act Executive Plan.

According to this article each municipality should establish a commission to preserve and expand green spaces and recognize if a parcel is garden or not. Therefore, there is a commission called "Commission Code 7" responsible for the last task. But unfortunately in practice this commission turned into a commission which gave the full decision making power to the municipality and which granted construction permission to developers by receiving 70% of the parcels. This makes the destruction of the gardens beneficial for both sides, either the municipality or the owner would benefit from a land use conversion, and, therefore, there cannot be any barrier in practice to stop this process. In 2009 the Green Act has been amended and approved and consequently Commission Code 7 has been established under the supervision of the CDC in the city council.

Presence of the representatives of municipality in the Commission Code 7 and the lack of budget for the city: The full decision making power is given to the municipality and the commission granted construction permission to developers by receiving 70% of the parcels.

⇩

There is flexibility in the execution of the regulations, the both sides, people and municipality are in a win- win situation when legal and environmental status is in the Lose- Lose Status.

Before any building permission is granted or any land use change is permitted, the developer or owner must control the parcel with this Commission to clarify if it is not registered as a garden. If during the construction any document shows that the parcel is a garden, the construction process has to be ceased and the person would be fined. The regulations concerning trees are laid down in Article 6 of Green Act which will be discussed later. As mentioned, the building process will be ceased but there will not be any destruction. Thus the owner knows that he has to pay for his failure but if he has been successful in building before being entangled, he can keep and use the illegal building. This is a part of the law which converts the illegal building into legal one and should be reconsidered. It states that an illegal building can be used because it has been built up. Consequently, there have been small buildings or rooms built in the gardens which are illegal but cannot be destructed.

The members of the Commission 7 or in other words the Garden Status Recognition Commission are a representative of the city council, the managing Director of the PGSO, a deputy of urban development or representative of urban services of the municipality.

Members of the Commission of Gardens (Garden Status Recognition Commission or Commission Code 7):
-A representative of the city council,
-The managing Director of the Parks and Green Spaces Organization,
-A deputy of urban development or representative of urban services of the municipality.

Decision making about if a parcel is a garden or not is a legal-environmental process; there is no member of Iran Development of Environment or the Environment Committee in the commission: No coherence between responsibility and function of the organizations

According to article Nr. 5 of The Code of Practice of the 2009 Amendment of the 1980 Green Act the municipality gives the permission to cut down the trees after the Commission 7 approval in any of the following cases: A non-fruit tree that has reached its productivity age and is chopped for the need to the wood; a tree which has been dried out by any unintentional reason like parasite; the other cases comprise trees which are on the building location, water canals, electronic wires, gas pipes, petrol pipes or any barrier to any construction as well as the trees on roads, roundabouts and pavements which prohibit the normal movement of the people in the city.

In the first two cases the owner has to plant a new tree whereas for the last two cases the priority is with transferring the trees to another place in a suitable season, and if this is not possible, a tree with two times more than that root perimeter of the existing tree ought to be planted by the owner in a place ascertained by the municipality.

In the case that the trees are cut down illegally, the owner will be fined by the municipality. According to article 6 of the Green Act, for each tree illegally cut a 20 to 200 Euros fine is considered and more than 30 trees cut illegally will end up to 6 months to 3 years in the prison. This fine is not comparable with the money the developer receives after having destructed the garden and built a high rise instead. For almost every builder this fine is what they count on as capital expenses which they have to pay in the beginning of the construction. If the fine is considered as maximum which is 200 Euros and a garden has 30 trees, that means that developers must pay 6000 Euros as fine which equals the value of 5 m^2 of a posh apartment in the north of Tehran. This means that the law should be altered in a way that no one prefers breaking it and pay the price because it is worth it.

Setting low fines for cutting the trees and not enough executive power for “prison” punishment in practice:
Encourages the destructors of the green lands

The punishments have to be compatible with the damage people make to the environment.

If the owner does not take care of the trees, according to the article 3 of the “Green Act”, the municipality has the legal power to receive the permission to irrigate and protect the trees and the owner will be charged the expenses plus 15% extra cost. The important point in this article is that there is no benefit for the municipality with a little budget to take care of the trees, and if they dry out, it can sell the building permission to the owner and earn money. It is also stated by written that the PGSO should support the municipality every year for the expenses of preserving and irrigating but in practice this organization does not have enough financial resources to pay for these costs and at the end there will always be problems between the municipality and the Parks Organization. It is logical that when they both do not have a certain regular budget and are responsible for the expensive costs of taking care of the trees, they try to find a way to earn money. One of the best ways is issuing the building permission which automatically destroys the green field and decreases its maintenance costs exposed to municipality as well. Therefore when municipality issues building permissions it can obtain money and decrease the high maintenance expenses of the trees. The second point is that there is no legal management body who inspects the garden in a certain period of time of the year and checks if the trees are taken care of by the owner or not. If no one controls the quality of the green lands in Tehran, there can hardly be a misusage reported. Therefore, this inspecting management is missing in the preservation structure of Tehran.

Lack of inspection team on the gardens: No monitoring system for green network of Tehran

⇩

To organize a green data base and control the quality/quantity of green fields

The lack of budget for the municipality: tax system by using environmental resources

⇩

Municipality issues permission to build high-rises and sell the right of building density and consequently destroying the gardens. Inefficient and unsustainable tax system.

According to article 4 of the Green Act the owners of the gardens ought to plant new trees replacing the trees for which they have to cut down by the municipality's permission. The new trees should have two times bigger root perimeters than the current trees if he wants to grow the tree in the same location and if the ones are going to be planted in the sites suggested by the municipality, the root perimeter should be at least 10cm.This article gives the absolute power of cutting off the trees to the municipality and, depending on the decision, the municipality has the financial benefit by giving the permission, but, at the same time, it is the only organization that has the legal power to recognize if a tree can be chopped off. On the other hand, in a climate like that of Tehran growing a new tree requires a lot of maintenance and irrigation costs, , it is very hard and slow to generate new green spaces and to grow up new trees and it takes a long time to have a tree, as appropriate as the one that has been cut down. Why should we lose the valuable existing assets of the city, impose more costs to urban authorities and consume more resources to get less valuable things back?

Article 6 of the Green Act is one of the articles in favor of preservation. This article states that if a person cuts down the trees in a way that allows the parcel to be divided and to be used for house development purposes, all the parcel will be under the ownership of the municipality. Although this article stops destroying the green space for the sake of urban buildings, the person will not be fined the 20 to 200 Euros for each tree illegally cut and article 6 of Green Act is not implemented.

Transferring the ownership of the gardens which are being destroyed, divided and built by the owner

⇩

In Practice this regulation is very hard to be implemented because all the current Iranian laws are directly or indirectly based on Islam rules and in Islam "ownership" is holly and very important and cannot be easily shifted.

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There are written laws but the guarantee of the right and complete execution of them has not been taken into consideration.

Like the "Kleingarten" regulations explained in Essen, according to the regulations in Green Act there is also a possibility for construction in Tehran under the certain circumstances; Site Occupancy index[1] 30%; Allowable building density 20% more than residential building density of the region in the Detailed Plan; High building and complexes construction is allowable with fulfillment of the requirements and the municipality is responsible for developing "incentive policies" to create and revive the gardens.

When certain requirements are fulfilled for high rises in gardens but they are not laid down in a written law, a suitable ground will be prepared for negotiation between the municipality and the owners which can end in losing more trees in the cities. In the case of Tehran with the dry weather and small annual precipitation, any garden should not just be preserved, but also freezing could be a better solution. Allowing any construction cannot guarantee the preservation of the trees, and even if some of the trees are chopped off to build the complexes or

[1] Site occupancy index or Site coverage rate or Plot coverage rate is defined as the size of the constructed buildings floor plate (e.g. first floor total area) as compared to the total size of the plot of land. For example if the plot of land is 100sqm and the Building Coverage Ratio is 60%, then the first floor constructed building can be up 60sqm.

high rises, the result is a huge damage to the environment. Given the climatic circumstances in Tehran explained before emphasizes that setting policies for construction in gardens, especially unclear regulations can be considered as one of the definite reasons of losing the green lands in Tehran in the years when legal requirements were insufficiently defined. Even if the municipality wants to give building permission to garden owners as an incentive policy, this should be according to the quality of the garden. There has to be a priority classification in the beginning of the process to find out which gardens should be frozen and which ones can be regarded more flexible according to their characteristics and quality and can this be partially built. Although there are regulations for construction, there is no regulation mentioned for planting or preserving the existing green space in gardens similar to Kleingarten in Essen. There have to be clear rules concerning the quality/quantity of the green part of garden parcels and not just the building characteristics.

No exact written conditions of how one can fulfill the requirements for building high-rises

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The regulations can be to a level negotiable and flexible. Both people and municipality try to benefit economically from this situation.

Article Nr.13 of the Executive Regulation Amendment of Article 1 of the 2004 Green Act clarifies two main responsibilities of the Parks and the Green Spaces Organization. First, it has a 10-days period to study the garden documents, particularly if they are in contradiction to Garden (or non-garden) vote in the commission and, secondly it has the high surveillance responsibility. In 2009, based on the amendment of the Green Act, the "Garden Status Recognition Commission" has been established under the supervision of the CDC in the City Council, consequently, PGSO lost its power. Although this amendment tried to regulate the garden problems and organize their issues under one commission, it turned out to cause conflicts and challenges between different organizations.

Also the technical building characteristics are defined in this article. If a parcel exceeds the 30% site occupancy index and it has been divided legally, there can be a construction on the same location of the first building with the previously implemented site occupancy index. To give an example, a building has been successful to get 50% site occupancy rate in a garden in the past and the owner gets the division permission. He can reconstruct with 50% site occupancy index on the same location. It means the new construction on each new parts of the divided parcel will be 50%, although it is more than legally permitted 30% in garden parcels. In practice, if a parcel is 1000 m^2 and has 50% site occupancy rate, 500 m^2 of the garden has been occupied by the building. When the garden is legally divided into two pieces, each 500 m^2, the permitted site occupancy rate will not be 30% according to garden rules but 50% according to the previous one. Nevertheless, the new building will be located on the same place of the old one and not on the green part of the plot but it brings more constructions, people and urban development to the place which in the very end causes more green land destructions.

The article 11 of this regulation introduces two different categories of gardens, those with less and those with more than 4000 m^2. For the first category, all the regulations are implemented according to this act; but for the gardens with more than 4000 m^2 the construction qualifications are based on the view, landscape, garden status and the possibility of as few trees destruction as possible. Apparently these criteria are not reasonable enough for a higher decision authority in urban planning. However these cases are being presented in a commission that comprises the members of the Architecture Council of the Region and Commission Code 7. Reviewing each garden status individually can be an efficient method to have less environmental damages, nevertheless this could be more successful if there would be a minimum rule regarding these gardens. Depending only on the decision of a commission makes the process to somehow inter-subjective and based on the opinions of the members of the commission and not on a written law which has previously been identified for situations like this.

The decisions about the gardens more than 4000 m^2 are based on view, landscape and reviewing each case individually in the commission

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Presence of the weak, non-strict laws, especially for the big green parcels with more ecologic values in green network of the city. These kinds of green lands have been frozen and strictly preserved in successful preservation examples.

The Latest Act is the Code of Practice of the Amendment (2009) of the Green Act of 1980 which also attempts to clarify the meaning of gardens and trees by law. According to this law, a tree is a wooden plant with a separate stem which can be a fruit tree or non-fruit and has at least a 15 cm root perimeter. In addition, a garden inside the city is defined by one of the following characteristics, at least 500 m^2, with the existence of a building, there should be one tree in each 16 m^2; with no building construction, in each 25 m^2 in average there should be one fruit or non-fruit tree; holding a garden deed, holding a previous positive vote as garden from Article Nr.12 of Urban land Commission and urban green spaces with private or non-private ownership.

The gardens inside the cities with the above characteristics are recognized by their City Council. The ones which are in suburbs or outside of the cities have to be recognized by the Ministry of Agriculture. The municipality should check any change in the number and quality of the trees inside the gardens. According to this act the municipality is obliged to have an inspecting team which controls the construction and the quantity/quality of the trees in the city of Tehran.

If there is a threshold value in the law, it should be justified. 500 m^2 surface area for a garden has not been logically or mathematically justified in the law and by a short review on the parcels in region 1 of Tehran for instance, it is obvious that many of the green parcels would be lost if this minimum area of 500 m^2 is applied. This debate is explained in other chapters. Another point mentioned in article 2 of this act is the division rule regarding gardens inside the cities. For these gardens the divided parcels cannot be less than 2000m^2.

In article 8 of this code it has been mentioned that citizens can legally apply for cutting down or transferring the trees by filling out a form which is available in the municipality. The municipality has to send the documents within one week to the Commission Code 7 and this commission has one month's time to respond to the application. If it takes more than one month, the municipality has the legal power to issue the permission. This process which can be legally accomplished in the municipality is a big threat to the existing trees. Although compensating the trees which have been cut off is the process that in European cities is being done, in a developing country like Iran and a city with a huge tension of construction, urban expansion and unsuitable climate for green lands this approach is not easily applicable. These forms could be used in those rare occasions when there is no other solution than destroying the nature, but it should not be applied in any ordinary situation when an owner simply wants to convert his garden into a building site.

The last and the best article of this act is article 13 which emphasizes on the cities with a low green space per capita. In these cities the municipality is obliged to produce green space preservation and expansion plans for the period of 5 years and present them to the Islamic city council to be enacted.

According to the Executive Code of Practice of the Prevention of Agricultural Lands' Division and Develop an Economic-Technical Parcels, passed in 2006, the Ministry of Agriculture is responsible for providing required credits such as grants and incentives, subsides, road accessibility between the farms and electronic wells.

As stated before, the Urban Land Act caused the establishment of the National Land and Housing Organization. The content of the act includes the definition of prime land, of barren and of undeveloped land. According to this act dividing gardens and farmlands is allowed within the city boundaries. Urban Lands Act was temporary for 5 years to encourage faster and easier urban-economic development during the war and to fulfill people's demands. After the Act had expired another act with the same content and some additional terms has been enacted and considered as a long term act. The importance of this act was so high that before the 2008 Green Act revision, this was regarded as the reference act relating to garden division. After the Green Act revision in

2008, this act lost its previous power. It can well be recognized that an act which has a temporary character is suitable for a city just for a short time, and implementing it for a long time may end up in land speculation and some misusages.

In the Executive Statement of Article 14 of the Urban Land Act a garden is defined as a parcel which is according to Commission Code 12 of the Urban Land act specified as a prime land and as garden or farmland. Commission Code 12 is the responsible commission to distinguish between barren lands and prime lands and the members are three representatives from the Housing and Urban Development Department. Having two definitions and two different organizations responsible for deciding if a parcel is a garden or not has caused a destructive situation for the gardens. Therefore, in 2007 the Urban Land Organization as a part of the MHUD complained to the Supreme Court that the municipality should just have the preservation responsibility, and the recognition of a plot as a garden is the task of the Urban Land Organization. After the Green Act amendment in 2008, this urban land act lost its previous power and, according to article 7 of the amendment, Commission Code 7 took over. These conflicts and challenges between urban departments with parallel duties cause a lot of expenses to the city and leave the gardens in an uncertain legal position as far as their preservation is concerned.

In the executive statement of the Article Nr.14 of Urban Land Act the qualifications of the garden and farmland divisions are more explicit. Gardens inside the city boundaries are categorized in three classes. Gardens which have public green spaces and can be owned by the municipality and be preserved as a public asset; Garden-Residential plots do not have any service or public green space land uses. The third class comprises other land uses. The second class can be divided and built up in two different ways. On the one hand, the garden-residential parcels which are connected to each other as a dense zone and have formed a valuable green texture in the city, on the other hand, there are gardens-residential parcels which have been distributed among different land uses and urban zones and are recognized as gardens according to the regulations.

For the dense –zone gardens the smallest parcel size for division is 2000 m^2 with 20% building density, with a site occupancy index of 10% and maximum of two floors on pilot or basement. The gardens less than 2000 m^2 have to follow these instructions as well. If the owner applies for a higher building density the regulation are as follows.

-For the dense-zone gardens between 2000-5000 m^2 a building density of 22.5% with 0.75 site occupancy index and maximum three floors on the pilot/basement is allowed.

-For dense-zone gardens of more than 5000 m^2 a building density of 30% with 0.75 FAR and maximum four floors on the pilot/basement is permitted.

For the separated gardens the regulations will be exactly as above (dense-zone gardens), thus the building density cannot be more than 30% and in addition the approach of keeping the maximum area of green space and the minimum tree destruction have to be followed. In this case the owner can have one more extra floor comparing to the zoning regulations of the region as an incentive policy.

The last class which contains other land uses has regulations totally different from the above. The garden owners who are volunteered to compromise with the municipality and give a part of their garden as public green space for free to the municipality, can change their land uses according to the regulations below and after the approval of the city council and the CC5:

Regarding dense-zone gardens, the percentage of the garden given to the municipality has to be more than 75% of the total area and 3500 m^2 while concerning separate gardens the minimum of 70% of the area and 3000 m^2 has to be given to the municipality. The main problem of having smaller gardens and green land use conversion in the last decade in Tehran especially in region 5, is based on this law. After gardens have legally been divided and split by giving 70% of the total area to the municipality, the land use can be changed to residential and consequently the trees can be cut off. On the other hand, there is no guarantee that the municipality will preserve the 70% which it owns and there is no inspecting organization which controls the function of the municipality in this situation.

As far as farmlands within the boundaries of a city, there are three different situations. Farmlands with no service or public green space land use can be converted into gardens and must follow the regulations of gardens

explained above. In this case the plan of planting trees ought to be provided and presented to the municipality. The second situation is that land use conversion of farmland to any other land use is permitted on the condition that the owner gives at least 70% of the total farmland area to the municipality and it converts this part to public green space, and the last situation is when the owner has no intention of changing the land use. As far as irrigated farming (wet farming) a minimum of 10 hectares and as far as dry farming a minimum of 20 hectares is necessary for a parcel to be defined as farmland.

4.5.4 Iran preservation plans

Three different preservation plans can be recognized as the most famous attempts for protecting the green lands in Iran. These plans have been produced for Tehran, Isfahan and Shiraz, three big Iranian cities. Here a short summary of each will be presented.

The Shiraz Ghasrodasht gardens (1510 hectares) were the target of the first plan in the northwest of Shiraz. In the recent years many residential and urban spaces have been developed in between the garden parcels of this region. In order to prevent more destruction in Ghasrodasht and its green spatial organization, in the 1989 Shiraz Comprehensive plan an area of 1400 Hectares has been approved as a special preservation area. In 1999 developing a preservation plan has been signed between Amood Consulting Company, Housing and Urban Development of Fars Province and Shiraz municipality. The main policy of this plan was to encourage the participation in equipping and managing the gardens to pursue three goals: preservation, conversion to public ownership and preparing a suitable ground for planning and designing. According to Commission code 5, 70% of the garden has to be preserved which has been followed in this plan as well. In the beginning the non-dense gardens with small amount of remaining green volume have been recognized. These parcels have to fulfill the following criteria: lack of sufficient quality for gardening; a high monetary value, being surrounded by the urban and residential parcels; removing them causes no damage to the connectivity of the gardens; selecting these parcels do not encourage the destruction of the adjacent gardens. There have been two ways to use these gardens in order to achieve the project goals. The first is to use them as a developing area for the gardeners who intend to build their dense gardens. This means to give them the building permission for these parcels instead of their own high-quality gardens. The second way is to sell these lands to cover the expenses of the whole project. The part of Ghasrodasht gardens which has to be preserved will be used by public in long term and this complex will turn into a green and tourism land use. In order to have more owners' participation, questionnaires have been distributed among all the owners. They comprise the questions regarding the consent to a special preservation zone, the satisfaction of the status quo situation, the desire to preserve their own private gardens, their idea about giving their gardens to the municipality and also the circumstances of any eventual contracts. The results of the questionnaires have been as follows: 70% of the questioned people do not agree on making a special preservation zone. More than half of them evaluate the present situation as inconvenient. 36% stated that with continuing the current circumstances, they cannot keep their own gardens, whereas 55% had the opposite opinion. 23% of the owners do not agree on giving their gardens to the municipality and more than 60% intend to give their ones under the contracts which have been agreed between the two sides. At the end, the solution to implement the preservation plan and prevent the garden destruction was to buy the gardens in different phases and look after them. This plan has to be financed by Shiraz municipality budget by giving the lands to the owners as areas to be developed with the Leasing organization, gardeners and residents cooperating thereby. The national and international investors can be effective in the procedure as well. This plan can alter the land market and the investment in the housing section and the tourist industry which can be a good possibility for covering more expenditures of the plan.

In 2009, the Naghsh-e-Mohit Consulting Company revised the preservation plan which has been produced in 1989 by Amood Company. In this new project different approaches to gardens have been presented: using the garden as an element in city development; garden preservation by deleting them from city environment; garden preservation by categorizing them and garden preservation by structured development of the city complex at macro scale.

Afterwards three different scenarios have been proposed: the first one is the active preservation and equip the gardens for public uses comprising following policies: the maximum usage of the low-quality lands inside the region; cooperation with the owners which are willing to invest in tourism section, presenting the development pattern based on the land use scale and the function of the region and categorizing the lands to facilitate owning them (giving up some gardens to preserve the others). In the analysis this scenario has been evaluated as idealist and unrealistic.

The second scenario is based on a combined approach of preservation and development. The garden region enters the urban environment and the limitations of the extreme preservation policies will not be followed. This scenario which has been chosen by the consulting company has been evaluated as practical and based on the owners' demands and housing market to convert land uses. It tries to combine the active preservation with different developments and, by using this way, to diminish the contradictions between public and private interests. By keeping the owners' rights and their cooperation in preserving their gardens and non-residential developments the project goals will be achieved.

In the first preservation plan set up by Amood company it has been proposed to give up the low-quality gardens instead of converting the land use of dense garden. This has been rejected in this plan. However, the experience in Jabal Derak region with more than 170 hectares of gardens has shown that the municipality owned just 100 hectares. The statistics show that with the remaining low-quality gardens which are going to be given up, the municipality will be able to buy only 14,74% of the gardens. So far this method has caused the population increase in the region which itself threatens the preservation process.

In the third scenario the Ghasrodasht gardens have been considered as an active section of the urban system; therefore, this region has to be developed and equipped to turn it into an urban green space with tourism/leisure function. To implement this plan into practice it has been proposed to transfer the residential development rights to the government, to increase the garden revenue by non-residential developments, to convert the ownership rights to stocks in bourse tourism companies and not to categorize the gardens (Bafte-e-Shahr, 2009, p.1-38).

After interviewing one of the Naghsh-e-Mohit company project managers by asking the questions in the questionnaires in chapter 6 a couple of new criteria have been derived. According to his experience in preservation in this area, ownership is one of the most important factors which has to be taken into consideration. He added that people participation is always a positive driving force. There has to be an ecological zoning for the gardens which shows which part of the area has more ecological value based on the age, size and scale of the trees. Macro scale structures of the green space in Tehran has to be produced as a map as well. Moreover, the cultural factors should not be ignored; the lack of connectivity to the place you live has a big influence ondestruction of gardens. He also emphasized that the municipality does not have enough money but rather land to support the preservation process. He admitted that for the sake of financial justice people living adjacent to gardens and using the cool fresh air have to pay for this luxury to the gardeners so that keeping the garden gets an economic justification. He rejected the combination of garden and high-rise and confirmed that the deep cellars or parking lots under the ground have destroyed the Qanats and the natural water available for the gardens. He pointed to Commission Code 5 and stated that its function has to be clear and transparent. At the end, he suggested to create more gardens in the city boundaries as a tool to prevent informal settlements. In his view, the land prices will rise that way and no slum can be formed. The results of the questionnaire he filled will be reflected in chapter 6 and by designing the criteria model of the research. Nevertheless, the plan has not been successful enough to preserve the gardens.

The second famous preservation plan which has tried to implement his strategies more in practice is that of the Najvan region in Isfahan. This plan has been produced by the Sharo-Khane Consulting Company in 2009 to preserve the gardens and agricultural lands in the western part of Isfahan. The main goals of this plan is to preserve, extend and improve the green open space; to protect the nature and green resources and using them to enhance the mental and physical health in the city; to lead the urban developments into new sustainable directions; to protect and preserve the values and the cultural, social and natural customs of the metropolis; to enact an environmental management of the natural urban tourism.

Due to the following reasons the urban development has been directed into the region of Najvan: population increase, their location in the vicinity of the city, accessibility to the urban service, the relative low value of the land and the predictable better future of the region, the problems of urban management, the lack of integrated development management with macro level approach.

By means of SWOT tables a complete analysis of physical, infrastructural, management and environmental problems has been conducted in this plan. The strategies of this plan comprise the prevention of the urban development, allocating the central zone to public green space, middle zone to gardens and farmlands with tourism function and the peripheral zone to centralized tourism, special housing development and urban service. The last zone has been the main financial source to achieve the project goals. If the owners use their legal rights, this zone will gradually turn into a residential district; therefore, this approach has been assessed as a barrier against the plan. The Commission of Planning and Development approved the land uses in this area as garden and agricultural lands to prevent more green lands destruction in Najvan.

The last well-known preservation project in Iran has started to be produced in Terhan by the Bafte-e-Shahr consulting company in 2009. In contrary to the other ones, this plan has tried to observe the preservation issues from different perspectives. However, combining the gathered information and analyzing them, managing a high number of staff specialized in different fields, giving priority to each aspect, decision for the importance of each and keep the balance between different parts made the project so complicated that it had to be given up after a year. Nevertheless, in the last trip of the author to Iran, she has been informed that the project has been re-organized and continued after a long break. The result of the new start has been policies and regulations of preservation in 9 different zones in Tehran. The three selected case study regions have been located in zones 2, 3 and 8 and general strategies have been developed for them but it is clearly emphasized that the exact regulations require a detailed study for these regions which is the main goal of this research.

In all these 3 zones the gardens have been categorized in two main groups: connected and disperse gardens. The gardens in the green connected intense zones can only have land uses compatible with garden and the minimum residential building density. The construction details are 20% building density, maximum 10% occupancy rate and a maximum of 250 m^2 on 2 floors above the cellar or the pilot. The conversion of the land use is just allowable to public green space and the ownership to the public one. The second group which comprise disperse gardens have the minimum division size of 2000 m^2, a maximum occupancy rate of 15% and maximum 4 floors with the minimum destruction of the trees. Regarding the farmlands inside the city, it is stated that they can get the land use conversion if the owner gives 70% of his land to the municipality and the municipality has to create public green space in this part (Baft-e-Shahr, 2009).

Although the revision of acts and presenting strategies in different zones is a more successful methodology in comparison to other projects conducted in Iran, but the main approach is based on current urban management, on municipality, on Commission Code 5 and 100 and accept the two main acts, the Green act of 1980 and article 14 of Urban Land. This fundamental base is itself a significant reason for the destruction of the green lands and any policy, rule and act has to try to modify the existing structure and re-organize it based on the universal successful models that consider the Tehran characteristics. By this review it can be perceived that Tehran needs a detailed preservation plan to preserve its green lands and to achieve its goals easier; a plan which gets distance from the main approaches of the existing projects can guarantee its real fulfillment with more certainty.

4.5.5 Summary and interim conclusions

In this part a brief summary of Iran preservation system will be explained. At the end, the summaries will be categorized in three different main subjects which express the significant characteristics of the Iranian green lands' preservation system and the reason of its malfunction. The main conclusions will be described and used in chapter 6.

The Iran Preservation system is based on the management structure, the regulations and the plans. These three factors which have been completely explained in this section should interrelate efficiently with each other to

achieve a better result and to preserve more green lands in Tehran. One of the main problems of green lands destruction stems from the weak connections between these three elements. The organizations in Iran are not categorized according to their scales and functions; therefore it is hard to generate any interaction between the organizations with big gaps. Regarding the management structure there is either one task which has been distributed between different organizations or one organization with different types of tasks which are sometimes in contrast with each other. There are no classified organizations specialized in certain kinds of responsibilities in the city. For instance, the municipality, the city council and the Ministry of Agriculture are the executive management bodies and the surveillance bodies at the same time. Moreover, the lack of coordination between different sections of one municipality for setting policies is another issue. There should be different organizations working separately for financial resource, technical section, producing plans and setting regulations, implementation and surveillance. The lack of an organization which is responsible and specialized just for preservation can be the reason why various affairs concerning this topic have been distributed between different departments, and sometimes parallel tasks are accomplished which is a waste of money and time. There has to be an organization with the main goal of "preservation" which does not benefit financially from destroying the trees. Different organizations with different functions have "preservation" as a part of their duties but it is not their main goal. This is only the case if all the garden documents and discussions about either to preserve or to convert the garden land use should be conducted in this unique organization.

Another problem in the whole system is the budget. As there have been no governmental financial means for the municipalities, they began looking for different creative ways to cover their expenses to provide the residents with better urban services, and to pay their employees. Support by the Ministry of Interior is restricted to only big civil projects. Due to the fragmented preservation structure in Iran, there is no certain budget allocated to "preservation".

There is no legally approved book for urban planning containing all technical rules and the basic regulations for each kind of plan, design and project. As it has been explained in Germany, a book similar to "Baugesetzbuch" from which the legal parts of each plan (Bebauungsplan) are extracted and consequently infraction is controlled by does not exist. This book should also be the base to set clear limits for responsibilities of each organization. Therefore, responsibilities must be clear and written in a related Act. As a result, the theoretical documents and the practical management must be in one hand. In Iran, however, there are lots of commissions which give a subjective essence to the decisions and many rules can be negotiated which is not acceptable in urban systems of universally successful examples. In addition, a written detailed law just for preservation and its conditions is missing in the whole system.

Another point which has impact on the preservation process is the responsibilities defined for the municipality. According to law, the municipality has lots of various tasks which cannot be done thoroughly by it alone; therefore many other departments are trying to fulfill its tasks and contribute to help the urban system work. One of the tasks which are in contradiction with its mission of preserving the green spaces is issuing the division permission. In Iran the municipalities should not have the power to issue the permission to divide gardens because, based on universal experiences, dividing gardens is a way to destroy them. Smaller parcels are more vulnerable and can easier be converted to city developments. The municipality cannot divide gardens/farmlands and get a share of them (70% or 75%) and at the same time claim that it is preserving gardens/farmlands. On the other hand, municipalities in the international case studies have more technical responsibilities and rather than that they are the main organization that preserves the green lands like Iran. A municipality should be a specialized and technical organization for urban issues. Moreover, the municipality should operate out of the CC5 because it receives financial benefits as fine from changing the land use from green to non-green or give more building density permissions as selling density. This interrelated cycle of responsibilities should be well defined and organized so that a new status of a municipality emerges in the urban management system.

In the Iranian planning system there is a lack of certain specialized plans. There must be different economic, incentive, technical and socio-cultural programs/plans for each organization to be implemented and followed. The plans are not multidimensional, and usually the socio- cultural aspects of them are very weak. Therefore people

participation in city management is a way too far from a real complete form and the new framework explained about people participation in Detailed Plans is not efficient and realistic enough to make changes for a city like Tehran. For instance in case of farmlands there is no cooperation between the farm owners and the city like a kind of Advisory board to help and consult farmers to increase their product in quality and quantity. If the farmers benefit enough from their jobs, they like to go on with the career in which they have more experience. In this situation a brief explanation is required; the owner is not necessarily the farmer and sometimes the farmers have been employed by the owners. As there are different groups in the preservation system and they should be satisfied with the plan so that it can be successful, there have to be supportive plans for the farmers and owners separately based on their benefits and preferences to give them more motivation for keeping the piece of green land.

Relating to the plans there is almost no garden preservation zoning in Iran plan documents, as just presenting one or two colors in the legend is not a comprehensive preservation plan that is based on the type and characteristics of green lands. A zoning with different rankings and priorities should be added to the preservation methods in which a strong preservation zone exists which means that no green land can be excluded from the zone and it is a kind of freezing the plots over a period of time. This was successful in the Quebec example, and in a developing city like Tehran this method can function positively as well.

Another point that might have caused problems in the preservation system is not to consider the whole green lands and green spaces in a city as a green network the parts of which are connected to each other. The plans usually have individual approaches and are limited to a part of a city as an isolated project with no connection to other green elements of this huge network. Therefore, the organizations responsible for green lands inside and outside of the city are also different and provide only a poor degree of connection. By separating the green lands into those outside and inside the city, there is a gap between the management structure and consequently in the green network.

The last but not the least is the whole process explained in this section. From 1980 that Green Act was passed till 2006 that its amendment was enacted, many unorganized rules by couple of organizations were implemented which were almost all in vain. The legal base was not well studied and approved and therefore the whole system was based on a poor ground. That is the reason why there were so many new rules and additional laws passed to improve a part of the system but the whole act must have been revised and adjusted to the current garden problems and land speculation in Tehran. Thus the City of Tehran lost a long time for preserving and missed a huge green part of it due to many challenges, discussions and conflicts between different laws, organizations and their responsibilities.

All in all, there are 3 main characteristics which have been repeated in the whole chapter in the boxes. If these boxes want to be summarized, the following points should be noted.

1. Many of the organizations in Iran are doing parallel tasks and therefore have many conflicts with each other. Consequently, a lot of public money is being wasted by same projects, plans and responsibilities so the whole urban system is working inefficiently.
2. There is a lack of surveillance in the whole urban management structure. On the other hand there is not enough power for execution of the plans and the combination of these two degrade the value of the written law. There are strong regulations in many fields but there is no guarantee of implementing them and no supervision on the implementation.
3. Legal base in Iran has in many cases flexibility and this characteristic of the laws prepares a suitable ground for both people and municipality to negotiate the cases individually in courts and commissions. Therefore, both sides can benefit from the system and have a win-win result for their economic situation whereas this situation is considered as lose-lose for juristical-ecological status of the city.

5 Case Study Specification

By using aerial photos of Tehran, the historical procedure of the green land destruction will be reviewed by the means of the aerial photos. As explained in the theoretical basis before, the green lands comprise urban gardens and farmlands. Tehran has 22 regions with different qualifications and 730km^2 in total; hence, the regions with higher priority according to the objectives of the research will be selected as the case studies of the research.

5.1 The change procedure in the surface area of the green lands in Tehran (Aerial photos from 1955 to 2000)

Tehran green lands have experienced an enormous change both in quality and quantity during the last 59 years. As no aerial photo had been taken of Tehran before 1955, it is the first scientific document which could be used as a comparison tool to distinguish the green lands changes in Tehran.

As it has been discussed in chapter 2 and 4, Iran law limits the definition of gardens to 500 m^2 parcels and will not be followed in this research; likewise it is by aerial photos that the green lands will be distinguished. This method is very much closer to what environmental scientists do. The other disadvantage of the Iranian regulation (500 m^2) is that people start getting the legal permissions to divide their big gardens into small 500 m2 and later remove the trees. In addition, since the municipality benefits from any urban construction by higher tax revenue, it rarely raises any objections against the garden divisions.

With this approach the research is a comparative study of the aerial photos from 1955 up to 2000 to highlight the historical-environmental background of Tehran, specify the regions that are likely to be more threatened and prove the decreasing process of green lands. In several Tehran regions there are no remaining green parcels as they have been destroyed during this period of time .Even if the garden history is very interesting, the current survey cannot focus on it. Figures 5.1, 5.2 and 5.3 show this process for 1955, 1989 and 2000 respectively.

By using GIS tools, the author has georefrenced the aerial photos, and making any green parcel distinguished in the photos led to the total surface area of the urban gardens and agricultural lands during different decades has been calculated. By overlaying new Tehran regions shape-file on the old photos, the “green” to “brown” process of each region could be worked out and the regions which have valuable green lands remaining through all destruction time can, with enough scientific reasons, easier be specified.

By taking into consideration the criteria of defining gardens (see chapter 2), in 1955 the total surface area of the urban gardens in 22 current Tehran regions (which definitely did not exist at that time) was about 30,000,000 m^2 whereas the agricultural lands amount to 74,000,000m^2. Table 5.1 shows the surface area of the green lands in the three years, 1955, 1989 and 2000, when the aerial photos have been taken.

Table 5.1: Change of green lands during 45 years in Tehran

Greenland	**Year 1955 (m^2)**	**Year 1989 (m^2)**	**Year 2000 (m^2)**
Urban gardens	30,273,002	29,245,044	15,261,523
Agricultural lands	74,301,140	22,513,500	16,532,096

Source: Analyzing aerial photos by the author, Baftshahr Consulting Company-Main Source: Iran Geometry Organization

According to the table, there has been an enormous decrease of urban gardens in less than 50 years. Tehran lost around half of its gardens and more than three fourth of its farmlands in this period of time. Taking into consideration that the serious impact of the weak regulations and the land speculation continued from 2000 up to present, the issue has worsened in the last 15 years compared to the mentioned period. Between 1955 and 1989

there is not a great difference in the garden area, as the city expanded rapidly at that time to the north and the green lands destroyed by urban sprawl had been compensated by creating new green spaces for the new urban settlements of Tehran. Moreover, the accessibility to water in the northern parts along five main river-valleys prepared a good, simple and inexpensive ground for expanding the green space between 1955 and 1989 in these regions of Tehran. This fact is obvious in the districts along the rivers in the maps. This phase (1955-1989) can be introduced as a transaction time between old Tehran with natural organic gardens and the new, urbanized Tehran with high-rises and business centers. Therefore, the whole system is getting prepared to be adjusted to the new circumstances and the land use changes in order to present a new image of the metropolis.

As shown in the 1989 GIS maps (Figure 5.2), public green space and, as a result, urban parks were important elements in the green surface of Tehran. However, up to 2000, due to the fast urban development and the dense destructions, this new category of green fields achieved an outstanding role in urban planning. Parks which had two main origins, manmade and natural, start to grow in the city and according to the aerial photos, shape and the registered records around 27,542,843 m^2lands can be considered as parks[1] in 2000 in Tehran (Table 5.2).

Table 5.2: The park development from 1991 to 2001 in Tehran

Year	Number of constructed parks	Area (m^2)
1991	99	931576
1992	70	436227
1993	103	629889
1994	37	229429
1995	54	298753
1996	64	620656
1997	33	1236753
1998	14	95943
1999	21	123571
2000	51	119699
2001	65	561332
Total	302	636114

Source: Laghayi and Bahmanpour, 2012, p.2442

After the 1979 revolution, Tehran widened its borders and the urban growth was almost out of control. Many farmers immigrated from their villages into the vicinity of Tehran and started to use and improve the quality of agricultural lands in the south of Tehran. Due to urbanization power and the high costs of living inside the city boundaries, they settled in south suburbs. As this study focus on the green lands inside the city boundaries and not in the suburbs, these farmlands could not be taken into account. However, this does not decrease the importance of these green lands near the southern boundary which can hardly be protected against urban growth. Thus, they have been shown in 1989 aerial photo in figure 5.2.

After 2000 the economic aspect of the farmers' lives became so difficult that living in the proximity to Tehran could not be based on an agricultural life. By reviewing the recent aerial photos, one can see that most of the southern green lands have turned into lands for apartments from which the previous farmers can benefit and can be more integrated and getting along with today urban life standards. As a consequence, the fact that Tehran regions have lost their agricultural lands cannot easily be perceived by observing the statistics only.

[1] Including forest parks like Chitgar, Lavizan and Pardisan with more than 18 km^2although their green texture is different from other small parks in Tehran; especially Chitgar and Pardisan park is mainly a recreational place for cycling, and in many parts the quality and quantity of the green volume is poor.

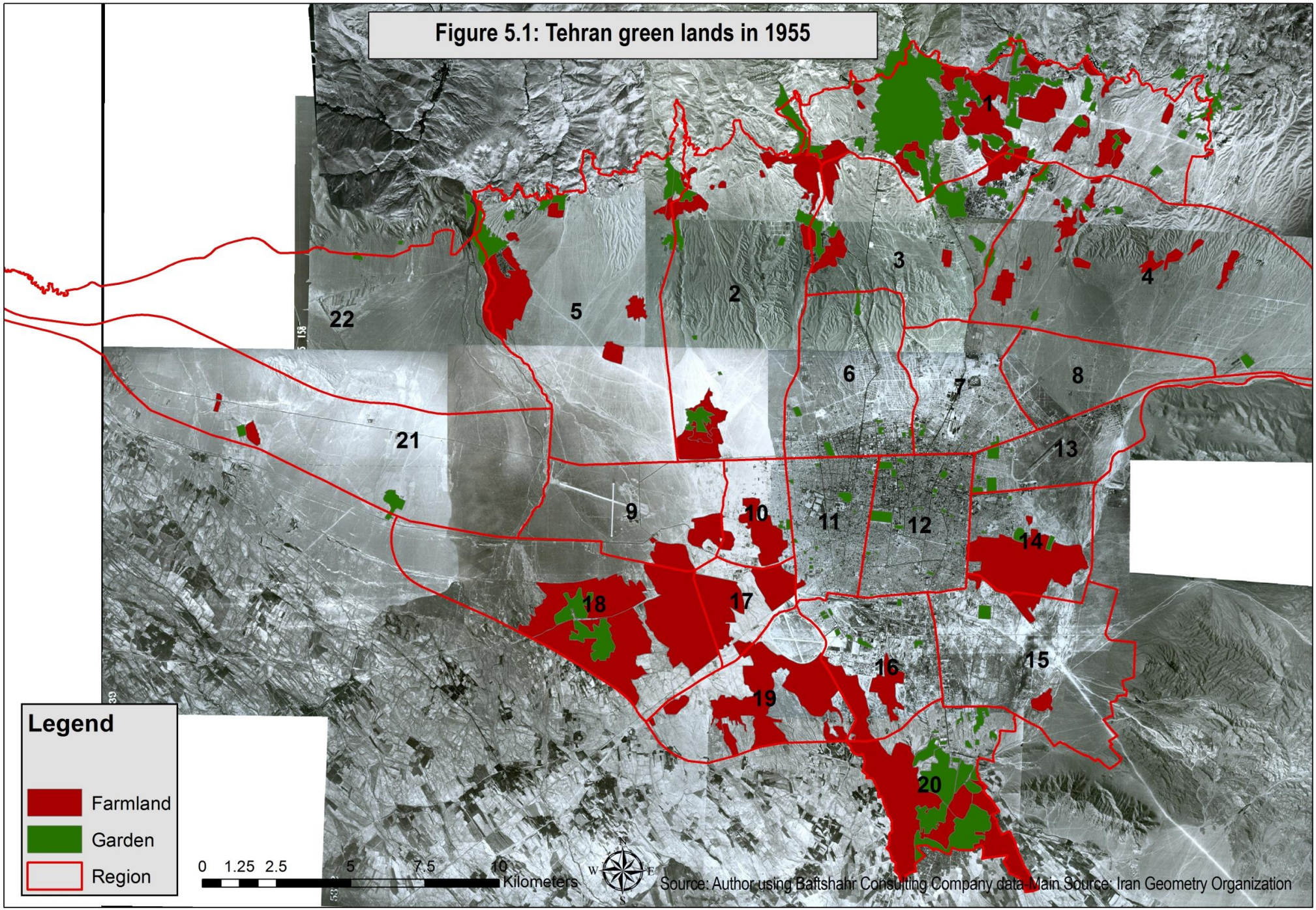
Figure 5.1: Tehran green lands in 1955
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Legend
Farmland
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Source: Author using Baftshahr Consulting Company data Main Source: Iran Geometry Organization

Figure 5.2: Tehran green lands in 1989

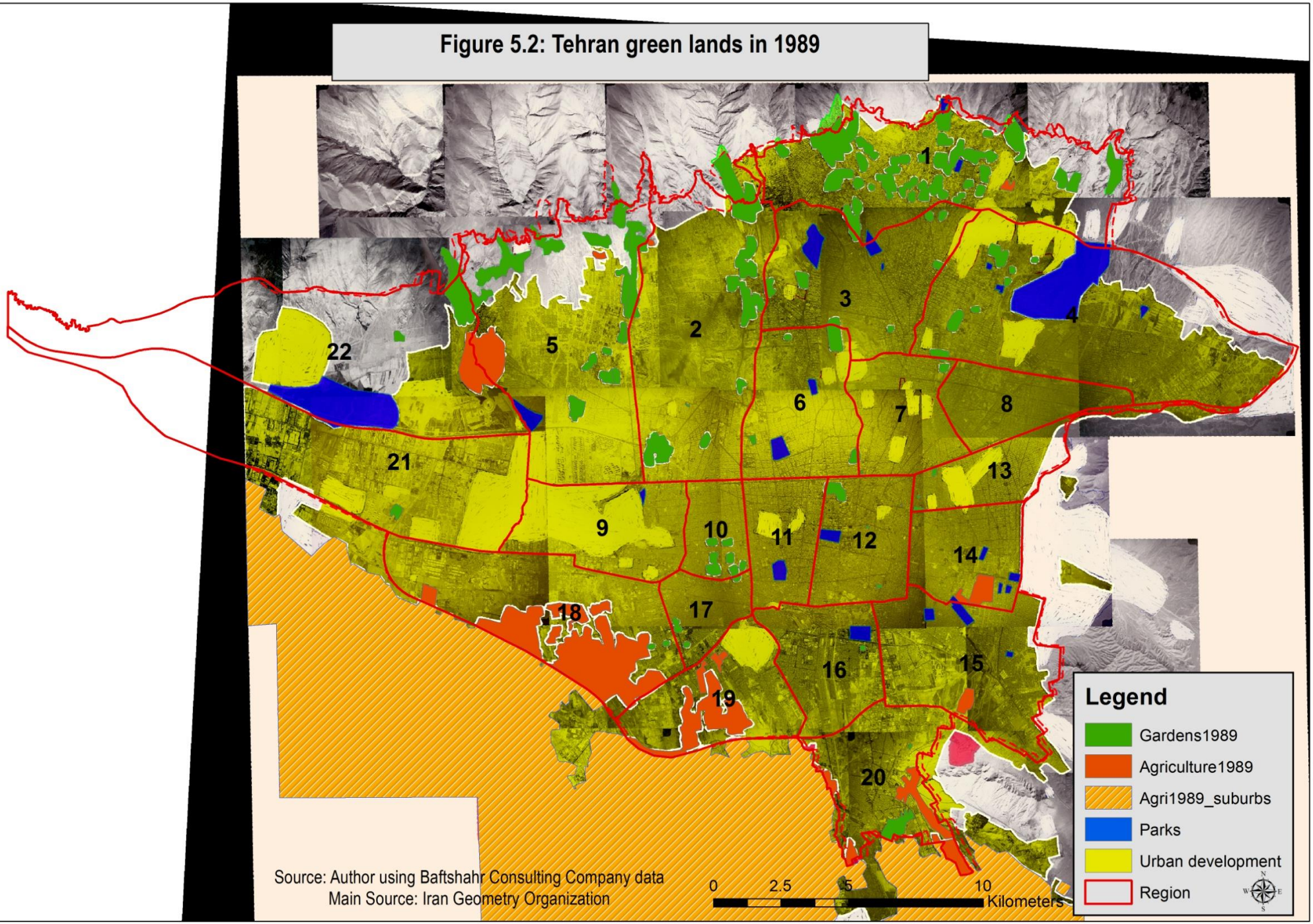
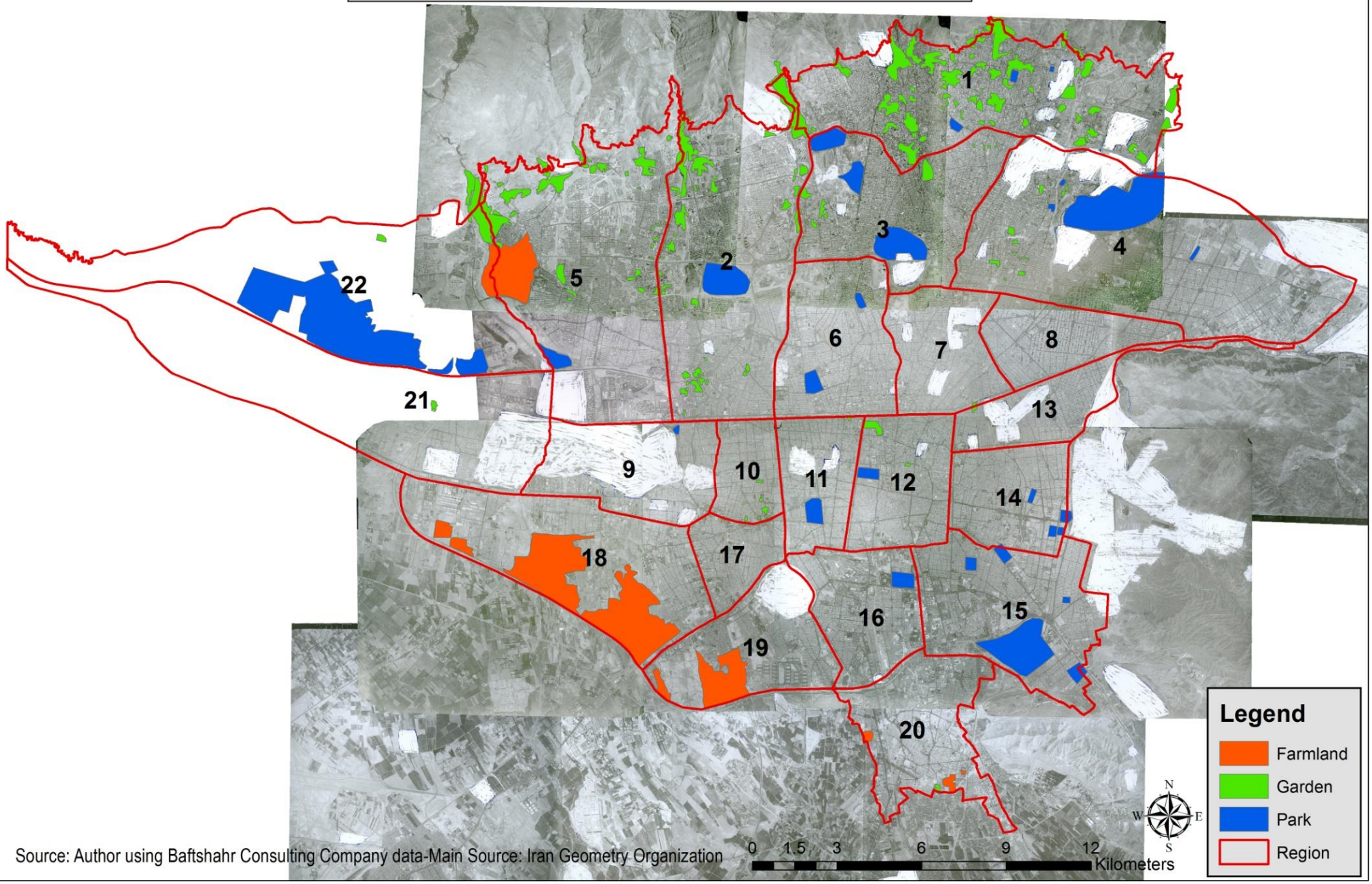


Figure 5.3: Tehran green lands in 2000



Source: Author using Baftshahr Consulting Company data-Main Source: Iran Geometry Organization

5.1.1 The historical procedure of urban gardens in Tehran regions (1955, 1989, 2000)

With this introduction concerning the whole quantity of green lands during 45 years, the necessity of an urgent action against the current process can be well perceived. In the next step, the certain regions which have higher priority to focus the study on will be specified. A thorough research on the changes in the surface areas of the green lands in each region and the current states is required; therefore, in this section the total surface area of green lands in each region and the change each of them has experienced in the last 45 years will be studied.

Table 5.3 indicates the changes of urban gardens during the last 45 years in Tehran. In 1955, due to the limited urban growth and the present Tehran regions not yet existing, only 4 out of 22 regions did not contain urban gardens. Regions 8, 9, 17 and 19 which are mainly center regions with water supply problems and warm, dry weather. However, many regions do not have a considerable amount of gardens either and in general the green density is limited to regions 1, 2, 3, 4, 5, 12 and 18. Unlike the first group of regions, the north regions, by having access to the mountains, cool weather, Qanats, rivers and a better earth morphology contains more garden lands. The gardens in these regions are concentrated along river-valleys or Qanats (explained in chapter 3) as shown in figure 5.4. In addition, the farms have been formed along the underground Qanats so that the orientation of the farms depends on the direction of the water.

Table 5.3: The change of urban gardens during the last 45 years in Tehran

Region / Time	1955(m^2)	1989(m^2)	2000(m^2)
Region 1	11,928,426	10,340,814	6,643,551
Region 2	2,384,833	6,626,284	3,250,481
Region 3	1,910,565	1,116,330	535,135
Region 4	785,259	1,201,936	262,545
Region 5	2,019,544	6,065,686	3,504,275
Region 6	409,126	767,273	No Garden
Region 7	159,525	164,178	No Garden
Region 8	No Garden	No Garden	No Garden
Region 9	No Garden	No Garden	No Garden
Region 10	92,074	834,437	48,067
Region 11	276,054	191,81	191,81
Region 12	737,621	666,078	202,474
Region 13	440,282	121,553	48,067
Region 14	250,180	No Garden	No Garden
Region 15	184,799	No Garden	No Garden
Region 16	281,334	37,409	No Garden
Region 17	No Garden	241,896	No Garden
Region 18	1,877,123	100,696	No Garden
Region 19	No Garden	No Garden	No Garden
Region 20	5,281,518	683,920	43,912
Region 21	466,145	172,435	58,542
Region 22	240,232	172,628	321,059

Source: Analyzing aerial photos by the author using Baftshahr Consulting Company data-Main Source: Iran Geometry Organization

Regions 8, 9, 10, 13, 17 and 19 had very few inhabitants or a low degree of “urbanization” at that time. Region 22 is a new region which has been an east suburb 15 years ago. The center regions have more built up parcels. The political center has been established in region 12 and that is the reason that it has relatively more green lands than other center regions. The gardens had been limited to palaces or man-made gardens. In many regions the area of gardens increased from 1955 to 1989 caused by the city expansion towards the north and East-west and creating new manmade gardens as the human settlements or taking care of the existing green areas by having an easy access to river and Qanat water. The regions with sufficient water supply according to figure 5.4 could increase their green fields, but since 1988 with the new policies of the new mayor, Mr. Karbaschi, the whole approach of the city planning in Tehran turned a new page. As has been explained in chapter 4 and will better be analyzed in chapter 6, by the building density and air rights Tehran started a rapid vertical and horizontal expansion. Therefore, the regions with a good access to water and consequently green lands, less air pollution and density, high topography and good view for high-rises were the first targets of the construction projects of the major. As a result, despite the growing figures in 1989 in some regions, the whole process up to 2000 shows a huge decrease of gardens, a process that proceeds with a higher speed today.

According to table 5.3, region 1 with its 1192 hectares of gardens was the most dense-green region in Tehran in 1955. Within 45 years it has lost more than 500 hectares of its green parcels. By 2000, regions 6, 7, 8, 9, 14, 15, 16, 17, 18 and 19 had no traces of gardens. Therefore they will be taken out of the case studies. The lack of gardens is due to the centrality of these regions, their difficult access to water supply, the rapid urban infill development in the center of Tehran, the proximity to the main Bazaar and the main business district of regional scale function. For all these reasons the gardens’ resistance against constructions was weak and their destructions became easier.

In addition, by comparing the results of the above table with 2009 QuickBird and 2012 Google earth photos, region 10 has the remaining green fields as the park category, region 11 a parcel as Marble palace, region 12 the city park (Parke-e- Shahr) and Russian embassy, Region 13 Booali hospital and the Azad University. In region 20 gardens have been limited to one small parcel, in region 21 a 2000 small parcel of can no longer be recognized in 2012 photos and region 22, has almost stayed the same with the small amount of gardens. With this explanation, it is clear that the mentioned regions have either no parcel in the status quo or very small parcels left which are not sufficient for this study analysis. Moreover, many of the remaining parcels have been conserved due to their land use as park, embassy, educational land use or hospital and could not adjust 100% the suitable conditions of a garden for the discussions of this research. This can prove the research hypothesis that the remaining parcels from 1955 to 2000 have mainly non-private ownership and therefore are less threatened. As a result, the research does not focus on these regions with complex socio-economic issues. Moreover, if the same process goes on, the remaining parcels are relatively safe due to their ownership.

Region 3 had around 500,000 m^2 gardens in 2000 and more than half of this number is comprised by the big garden-villa of the English embassy. The rest are small separated parcels which have been mainly destroyed till 2012 and have similar characteristics to the gardens in region 1 with less density and concentration. Region 4 has more and less the same gardens as in 2000 but the land uses are mainly military and baroques. The most important green element in region 4 is the Lavizan Forest Park which is a recreational area with about 1100 hectares. This parcel has not been considered in the calculations of this study since it has park land use. As a result according to the aerial photos comparative study, these regions, concentrated in the north half of Tehran, have the suitable current green lands for the further research, on urban gardens and consequently the case studies of the research up to now are regions 1, 2, 4 and 5. It should be stated that based on the green quantity region 4 has the least priority.

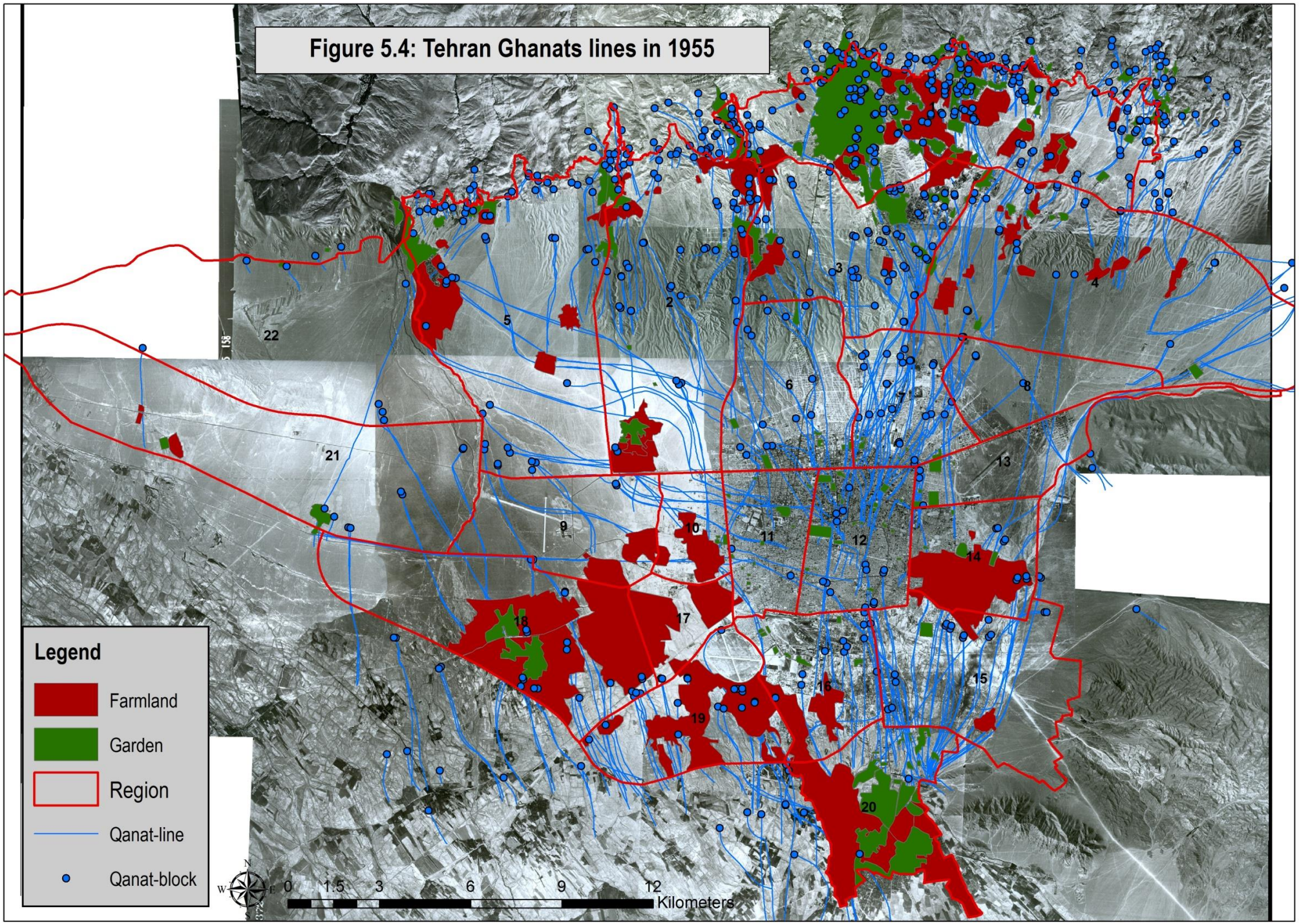


Figure 5.4: Tehran Ghanats lines in 1955
Legend
Farmland
Garden
Region
Qanat-line
Qanat-block
0 1.5 3 6 9 12
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5.1.2 The historical procedure of farmlands development in Tehran regions (1955, 1989, 2000)

Due to the urbanization and the fundamental activities urban life requires, agricultural lands spread their boundaries more outside of the city borders. So in Tehran, the southern regions which contain agricultural lands are themselves surrounded by farmlands. By perceiving the thread of the urban growth in the south of Tehran and its impacts on the non returnable farmlands, this group has been chosen as a part of this study as well. However, as a case study, only the agricultural land areas inside the city will be discussed.

Table 5.4 shows the changes of the surface area of the agricultural lands during the 45 years, from 1955 to 2000. Region 18 with its 1511 hectares of farmland accounted the most agricultural lands in 1955 and it lost almost one third of them until 2000.The current Google Earth and 2009 QuickBird photos show an increased reduction in the surface area of the green lands in the last decade.

Table 5.4: The change of farmlands during the last 45 years in Tehran

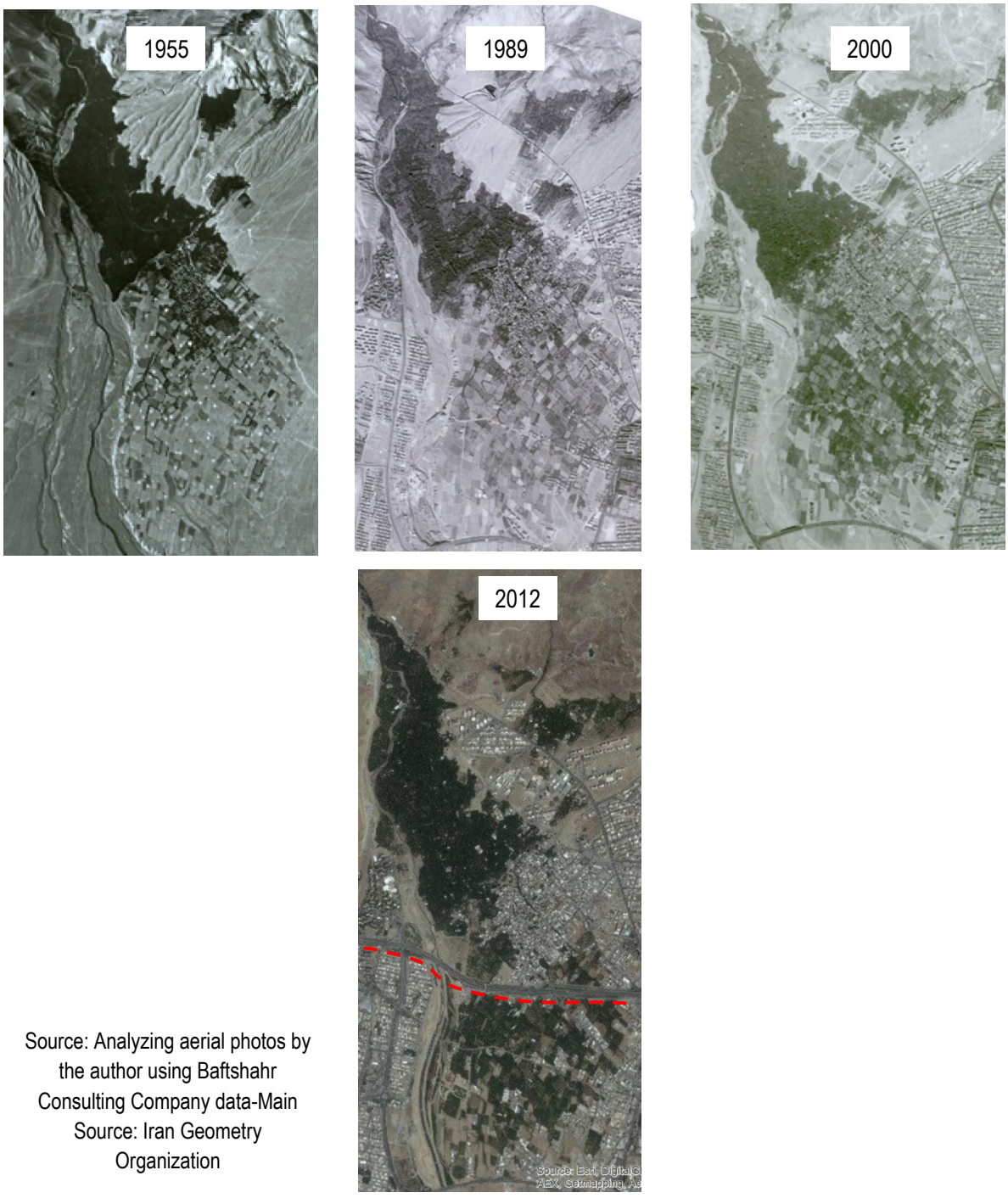
Region / Time	1955 (m^2)	1989(m^2)	2000(m^2)
Region 1	8,688,796	140,009	No Agricultural land
Region 2	4,703,514	48,741	No Agricultural land
Region 3	2,516,197	No Agricultural land	No Agricultural land
Region 4	2,807,341	No Agricultural land	No Agricultural land
Region 5	4,740,578	3,076,618	3,242,324
Region 6	No Agricultural land	No Agricultural land	No Agricultural land
Region 7	No Agricultural land	No Agricultural land	No Agricultural land
Region 8	No Agricultural land	No Agricultural land	No Agricultural land
Region 9	2,102,046	No Agricultural land	No Agricultural land
Region 10	2,061,026	No Agricultural land	No Agricultural land
Region 11	66,708	No Agricultural land	No Agricultural land
Region 12	40,278	No Agricultural land	No Agricultural land
Region 13	No Agricultural land	No Agricultural land	No Agricultural land
Region 14	6,010,978	924,484	No Agricultural land
Region 15	1,178,064	415,939	No Agricultural land
Region 16	2,932,801	No Agricultural land	No Agricultural land
Region 17	4,185,385	No Agricultural land	No Agricultural land
Region 18	15,118,664	11,155,466	10,154,063
Region 19	7,656,613	4,170,157	2,814,647
Region 20	9,342,363	2,582,086	321,061
Region 21	362,323	No Agricultural land	No Agricultural land
Region 22	No Agricultural land	No Agricultural land	No Agricultural land

Source: Analyzing aerial photos by the author using Baftshahr Consulting Company data-Main Source: Iran Geometry Organization

Region 1 was one of the dense agricultural regions and well-known as an area with lots of barley and grain farmlands 59 years ago; more than 800 hectares disappeared before 1989, and currently it has no more farmland left. Region 20 experienced the most dramatic statistics by falling from 934 hectares in 1955 to less than 33 hectares in 2000. By the year 2000, most of the regions had lost their agricultural lands and the only remaining regions were 5, 18, 19 and 20. By comparing the 2000 and 2012 photos, the small green parcels in region 20 have become smaller, and all the agricultural lands in this region spread from the city boundaries out to the southern suburbs of Tehran. Most of the agricultural lands in this region, especially in the south of the region, have been substituted by the new human settlements. In region 19, the amount of farmlands has decreased dramatically. Thus, in terms of the farmlands quantity, region 19 and 20 get the lowest priority. Nevertheless, region 5, 18, 19 and 20 enter further studies for choosing the best case studies.

In region 5, a new highway (Hemmat) has been constructed and divided the gardens and farmlands into two separate parts which prepared a suitable ground for the new constructions along the road network and destruction of more green fields in region 5. Figure 5.5 presents the aerial photos of the gardens and farmlands in region 5 (Kan district) and how they have been separated into two parts and consequently destructed after building the highway. As it can be seen in the figure, the accessibility is a positive factor in the city which causes and is the result of the urban developments. However, simultaneously it is a threat for the green fields, and when it develops, it impairs the green texture around it. In region 5 the highway itself destroyed the green lands and its surroundings were/are gradually being destructed, as well. Moreover, the land price increased along the highway as explained by Harvey in theoretical basis and keeping agricultural land was no more worth it.

Figure 5.5: The effects of road network (after 2000) on the green fields in region 5



Source: Analyzing aerial photos by the author using Baftshahr Consulting Company data-Main Source: Iran Geometry Organization

5.2 Socioeconomic data of selected regions

Based on the previous discussions, the regions selected as the case studies on urban gardens are regions 1, 2, 4, 5 and the agricultural lands regions are 5, 18, 19 and 20. However, as the socioeconomic structures of the north (gardens) and the south (farmlands) are totally different, different approaches in specifying the criteria and also the policies which will be set afterwards in this research are required.

Table 5.5: The average land price and residential apartment price from 1992 to 2014 in region 1 and Tehran

Year	The average land price (m^2) in thousand Rials[1]		The average apartment price (m^2) in thousand Rials	
	Region 1	Tehran	Region 1	Tehran
1992	684	430	790	463
1993	794	476	873	516
1994	858	553	1,093	595
1995	1,499	886	1,833	958
1996	20,25	1,238	2,473	1,603
1997	2,413	1,281	2,449	1,560
1998	2,382	1,374	2,570	1,558
1999	2,538	1,448	3,081	1,755
2000	3,643	1,868	3,648	2,251
2001	5,220	3,083	6,081	3,198
2002	7,745	4,640	8,746	4,810
2003	-	5,923	11,066	5,996
2004	20,632	5,974	11,493	5,841
2005	14,722	6,445	13,920	6,497
2006	11,723	7,989	19,950	8,314
2007	42,478	18,242	32,472	15,098
2008	-	15,433	42,179	17,781
2009	44,841	21,103	28,401	16,078
2010	40,335	21,564	27,520	16,933
2011	54,308	27,106	39,318	20,730
2012	77,913	40,305	60,658	30,569
2013	123,814	55,465	87,173	40,407

Source: Roads and Urban Planning Organization of Tehran, 2014

[1] On 29.12.2014 one Euro equals 43000 Rials.

The social status of the people in Tehran differs by geographical location, and the difference is so great that many issues in the city have social origins. Region 1 is the region with the highest status both from a social and a topographical point of view. Nice villas, huge modern apartments with a view over all Tehran from high mountains make it a special place to live. Real estate price and property status is much higher than in other regions, and with the weak economy of the last decade in Iran, "Land Speculation" has become one of the most common issues of the region. Compared to region 4, 5 and the southern regions, as based on Iran Statistic Organization 2006 data, this region has more inhabitants who do not hold an active job but have an income by simply speculate on property market. Table 5.5 shows the difference between the land price and the residential apartments over a period of last 12 years in region 1 and in comparison with the average price in Tehran. This table obviously submits the high speed increase in the real estate prices in Tehran. The term "lands" often refers to what are called urban gardens is this study. The big difference between the land and the apartment which will be constructed in the place of the land shows the suitable benefit of this business. It should be emphasized that this difference is just for one apartment; however, by using the tools of high density permission in region 1, a high-rise can be substituted. In general the prices in this region are much higher than the average of Tehran. This part is explained in details in chapter 3 and 6.

According to Iran Statistic Organization, 92% of the inhabitants of this region have at least basic education in contrast to the 89% in region 5 and 87% in region 4. As indicators of the socio-cultural level of a community, valuing the education and women's social activities can be mentioned. With this in mind, it can be observed that 91% of the women in both regions 1 and 2 are well-educated whereas there are 89% in region 5, 78% in region 18, 75% in region 19 and 79% in region 20.

In the northern part of the city from 13% of the women in region 1 to 16% in regions 2 and 5 work outside of their homes. In contrary, in the southern part, women show the tendency to stay at home as housewives and do not participate in social activities outside their homes.

Table 5.6 highlights these social conditions. Attention should be paid to a misleading indictor, i.e. the percentage of women not working in different regions. For women in region 1 the reason for not working is due to the fact that they spent their time more on social activities such as sport, language classes and cultural happenings, they often do not need the money either whereas the reason for other regions is simply based on not valuing women's work.

Table 5.6: Socioeconomic indicators in selected regions

Region / Data	Region 1	Region2	Region4	Region5	Region18	Region19	Region20
Educated Persons	92%	92%	87%	89%	81%	79%	82%
Educated Women	91%	91%	86%	89%	78%	75%	79%
Employed Women	13%	16%	11%	16%	6.5%	5.8 %	8.7%
Housewives	41%	37%	46%	46%	49%	50%	47%

Source: Derived by author from Iranian Central Statistic Bureau 2006-Tehran

By looking closer to socio-cultural conditions of region 1, two categories of social inhabitants can be distinguished. The first category is "the-old-northern inhabitants"; they are mostly well-educated and have lived more than a century in this region and usually known as people whom were connected to the previous regime. Their home is their identity and they will not trade it for property speculation, therefore they hold tight to their villas to keep their social status. The only way these villas fall into the hand of property developers is when the owners pass away and villas has to be split between the heirs who try to get their shares by selling them further.

The second category are the “New-comers” who have been explained in “filter down” and “blow up” theories in theoretical basis of chapter 2.They are not born and grown up here and therefore have no personal connection to their homes. They simply moved here as a gesture of going up the social ladder. Their home is simply another investment to them and they use it on property speculation. They simply let their green land go for the sake of making more money by finding legal ways to raise dense apartment blocks on the ground of villas. This social structure puts region 1 on the top of the priority list, because this structure in addition to regulations, municipality and economical situation, accelerates the destruction of green land if compared to the other regions.

Statistics show that in the recent years region 2 is also developing the similar way as region 1. Region 5 with one of the most important urban gardens, surrounding the main Kan River stemming from Alborz mountains, has a mid to low social level compared to regions 1 and 2. Region 4 has a totally different social structure; inhabitants have a “simpler life style”. Here, gardens are scars with low diversity/quality of trees and, as stated before, the most important green parcel is Lavizan forest park which is not counted in this study. The inhabitants are middle-low class citizens usually not involved in land speculation, more occupied with making ends meet. In comparison to other regions in the northern parts of city, inhabitants are less educated and about half of the female population has no social responsibility outside of their homes. The small remaining green parcels are not threatened by property development due to the socio-economical structure of the region. Region 4 has therefore been extracted from the case study in order to concentrate on the more endangered regions with more threatening factors.

Regions in the south of the city with agricultural lands have a different social texture. Their inhabitants with a low education/economical level (table 5.6) are open to land speculation to improve their socio-economical status. Without governmental support, their produce from the land has a little turnover compared to developing the land into apartment buildings. For this reason, they are in the inner-region threat group, just like region 1 but with a totally different approach. Therefore, all 3 southern regions i.e. 18, 19 and 20 remain in the case study based on their social conditions.

5.3 Two-step criteria method to optimize the selection

Six regions of Tehran have been selected out of 22 based on socioeconomic studies and aerial photos analysis on green lands reduction during 60 years; Regions 1, 2 and 5 in the field of urban gardens and regions 5,18,19 and 20 in the field of agricultural lands.

The case studies should be reduced to a smaller number of regions without destroying the whole body of the research so that the research can be more focused on each. The main reasons of reducing the number of case studies are to make the research more concentrated, to prevent working on regions with similar characteristics and creating repetitive sections, to prevent the whole research from becoming too long without necessity and with taking into consideration that each region has a long Detailed plan (200,300 pages) which has to be summarized and translated in the research as an upper-hand urban plan.

In addition, each region can be as large as European cities by area and by population. For instance region 2 has an area of 48 km^2 and a population of more than 600,000. Therefore, working on each region is equal to working on a city in Europe.

Among the chosen case studies (Region 1, 2, 5, 18, 19 and 20) regions 1 and 2 have unique characteristics which make them stay on the case study list. The unique characteristics of region 1 are the special land speculation procedure, the importance of its gardens for Tehran as a whole, the special economic status, land price, the existence of political land uses in the garden parcels (garden-embassy and garden-palaces) and different social level from the rest of Tehran.

The unique characteristics of region 2 can be summarized as being the most important region regarding land speculation next to region 1, becoming more important in the last years in different aspects, the existence of several undeveloped or vacant lands with governmental ownership, the linear gardens along river-valleys, the different urban designs (more cluster forms) developed by the Canadian designers before the revolution. Its linear

gardens along river-valleys are very similar to the region 5 gardens. In addition, region 2 Detailed plan has been chosen as the best Detailed plan out of 22 Detailed plans in 2007.

Regions 18, 19 and 20 have been selected as the regions containing agricultural lands. Due to almost identical socioeconomic characteristics and types of green lands, one of them could represent the whole issues of the south of Tehran. Therefore, the air pollution data as well as the surface areas of the agricultural lands would enter the second step criteria process to filter the most appropriate case studies for the current research.

Since focusing on the agricultural lands in the southern regions is the main task of this research, their surface areas have been compared in the latest aerial photos. The larger the surface area is, the higher the priority will be. According to this data, the priority orders of the southern regions are as followed: Region 18, 19 and 20. This means region 18 has the most amounts of agricultural lands. The agricultural lands in region 19 and 20 have been destroyed over time and they are mostly concentrated on the fringe of these regions, out of the limits of Tehran.

Climatologic criteria have been gathered from the "Air Quality Control Company" which is a subsidiary of Tehran Municipality. Based on the news released by this organization, Tehran residents experienced unhealthy and very unhealthy air on 218 days of the last year. This means according to the standards released by the Committee on Medical Effects of Air pollution (COMEAP) which have been explained in chapter 2, the air pollution banding was in high or very high band (Figure 2.12, 2.13 and Table 2.1 in chapter 2). As second step criteria, air pollution indexes will be compared here between the case studies regions according to universal standards. Table 5.7 shows the latest data in different regions. Note that not all of the data were available in all the dates and therefore a period of three years have been chosen to compare the hourly average amount of indexes with each other.

Table 5.7: Air pollution indexes in the selected regions of Tehran from 21.03. 2011 to 21.03.2012

Region / Indexes		Region1	Region 2	Region 5	Region 18	Region 19	Region 20
O_3 (ppb)	$\bar{X}$[1]	23.8	31.6	24.2	7.8	46.2	13.9
	Q_{95}[2]	79.6	72	60.3	35.6	154.5	43.9
	σ[3]	25.5	20.5	18.6	11.5	51.7	13.5
NO2 (ppb)	$\bar{X}$	34.1	70.6	51.8	20.6	31.7	34.3
	Q_{95}	61.6	161.5	125.8	33.6	59.2	82.4
	σ	14.9	43.9	40.3	6.9	16	30.6
PM_{10} (microg/m3)	$\bar{X}$	90.8[4]	52.8	58.8	126.5	89.3	55.4
	Q_{95}	-	95.1	113.2	239	183.5	115.5
	σ	-	30.3	40	113.9	57.2	38.9
CO(ppm)	$\bar{X}$	2.5	2.4	2.7	1.4	3.3	2.6
	Q_{95}	4.8	5.1	5.1	3.2	6	5.6
	σ	1.2	1.5	2.4	0.9	1.5	1.6
SO_2 (ppb)	$\bar{X}$	39	45.5	27	54.4	14.8	23.1
	Q_{95}	62.5	63.1	39.4	133.5	26.9	36.5
	σ	15.1	19.7	6.6	40.2	8.1	9.6

Source: Derived by author from Tehran region climatologic data, Air Quality Control Company, 2011

[1] Average

[2] 95th Percentile: The 95th percentile says that 95% of the time, the usage is below this amount. Just the same, the remaining 5% of the time, the usage is above that amount.

[3] Standard deviation

[4] PM_{10}data was not a available for 2011. Therefore 2012 data has been used.

In addition to the special socioeconomic and environmental criteria of region 1, PM_{10} is in a very high range comparing with other regions; this fact which is to confirm the decision of working on this region as well.

Region 2 with a general higher pollution levels than region 5 and O_3, NO_2 and SO_2 values that are the highest in comparison with many other regions of Tehran can still stay at the top of the list of priorities. This can stem from the southwest wind of Tehran which blows the indexes in region 5 first and then with a less power reaches region 2. Thus, this can be kept in mind that with the same green lands characteristics and partly the same socioeconomic characteristics of region 2 and 5, region 5 can be omitted from the list and region 2 can be the representative of region 5 for this criterion.

Compared to other regions in the table, region 20 has almost better statistics and the amounts of green lands remaining in this region are so small to be a part of the dissertation. According to all above mentioned points, a higher priority belongs to other southern regions than region 20. However, this will be examined with quantitative methods further.

Generally, the air pollution criteria of region 19 are worse than those of region 18. This is partly due to the green lands destruction in this region in the last decades. Studies show that the speed of constructing building on the agricultural lands has been very high during this time. The numbers of agricultural parcels are so few that another region with mainly the same similarities could be a good representative. On one hand, region 18 has almost the same socioeconomic characteristics as 19. On the other hand, the amount of PM_{10} and SO_2 which play a crucial role in air pollution is extremely high in region 18, giving this region a top priority for the current research.

In addition, region 18 has the largest amount of agricultural lands among the southern regions. With several socioeconomic characteristics in common with other southern regions makes region 18 the representative region for the south of Tehran and will have the top priority for the current study. In table 5.8, it has been tried to turn the qualitative criteria into quantitative ones to be able to evaluate and decide for the highest priority among the 6 case studies. It is a combination of "checklist of criteria" method and "Goeller scorecard" methods in the evaluation methods of the urban planning. The colors in the Goeller method have been turned into number weights in this method which is similar to multi-criteria evaluation methods done by GIS.

Table 5.8: Multi-criteria evaluation to choose the region with the highest priority

Region / Criteria	Agricultural lands surface area	Weight	Gardens surface area	Weight	Socioeconomic criteria	Weight	Special, unique characteristics	Weight	PM 10	Weight	O3	Weight	Other air pollution indexes	Weight	Total score of priority
Region 1	0	-	1	5	1	5	1	5	1	4	1	4	1	5	**28**
Region2	0	-	1	5	1	5	1	5	1	2	1	5	1	5	**27**
Region5	1	2	1	4	1	3	0	-	1	2	1	3	1	4	**18**
Region18	1	5	0	-	1	3	1	4	1	5	1	1	1	3	**21**
Region19	1	4	0	-	1	3	0	-	1	3	1	4	1	4	**18**
Region20	1	3	0	-	1	3	0	-	1	3	1	2	1	2	**13**

Source: Author

In the above table, first column of each criteria shows if that certain criterion exists in the specified region or not; the result is either '0' or '1'. The second column shows the relative importance, amount and quality of these criteria (air pollution indexes, green space and etc.) and has been shown as 'weight' which has a band from 1 (low) to 5 (high). As mentioned before, PM_{10} and O_3 are known as the most important indexes by EPA. Thus, they have been studied separately in the table.

The unique characteristics of region 1 and 2 have been explained before. The unique characteristic of Region 18 is that Yaftabad has been considered as an outer regional commercial center of the whole city of Tehran in the

Comprehensive plan. This approach guides the urban development to this region and prepares the grounds for building up on remaining green lands. A huge surface of region 18 is allocated to Yaftabad area.

As mentioned before, region 5 has both gardens and farmlands; the gardens have most of the characteristics of the ones in region 2 and the farmlands are similar to those in the southern regions. Thus, the results and policies for other selected regions can be combined and utilized in region 5 as well. Moreover, according to the above discussions and the quantitative table the priority of this region is not very high either. As a result, by taking all these aspects into consideration, region 2 will be the representative for region 5 with widely the same socio-economic issues, similar garden types and more unique characteristics. In addition, according to the previous discussion, region 18 can be the representative for region 19 and 20.

Thus, by the means of the second step criteria method, the chosen case study areas are regions 1, 2 and 18. Region 2 as the representative region for region 5 and region 18 for both regions 19 and 20. By reducing the numbers of case studies, the study can be more concentrated on the local issues of each region, is more capable of working on more details and solving the problems with more manageable limited data.

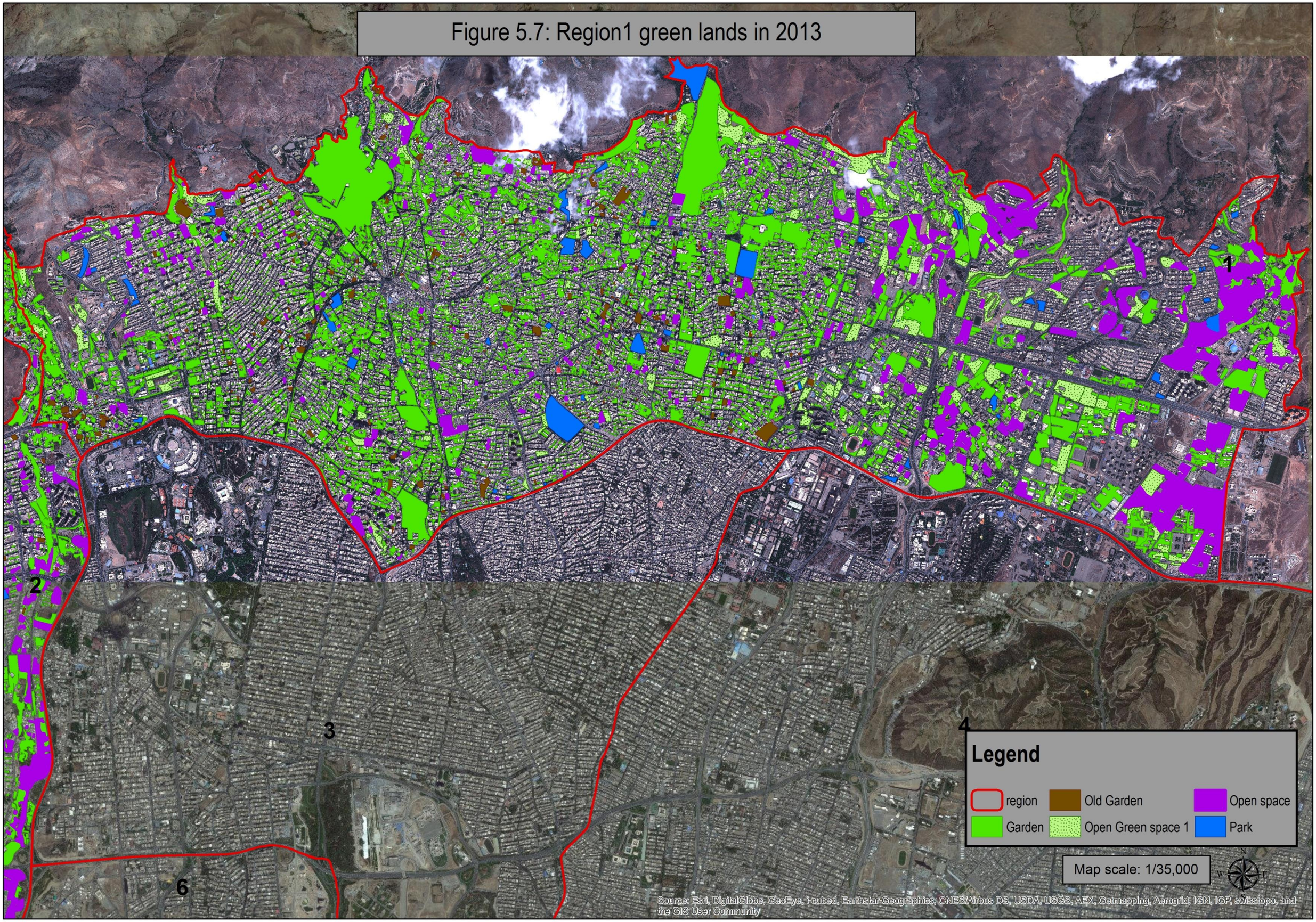
5.4 The current green status of the case studies (region 1, 2 and 18) in 2013

In the first phase of the research, on one hand, the destruction development of green lands has been analyzed using aerial photos from 1955 to 2000. On the other hand, by using the results of aerial photos analysis, air pollution indexes information and socio-economic characteristics in the two-step criteria method, the case study regions have been chosen. In this part a more detailed analysis on the selected regions will be conducted, and by using the high resolution aerial photos of 2013, the research will focus more on the green lands of regions 1, 2 and 18. The total area of these three regions is about $121\mathrm{km}^2$. This part of the analysis is totally different from the previous one; as the high resolution aerial photos make the deep, detailed and exact analysis, even of each tree, possible. The quantity of the green lands and the changing process will no longer be discussed, but rather will the quality, texture and the type be analyzed and further used in the developing policies of chapter 7. It can be stated that due to the low quality of the tool in the past, which was the only possibility, there has been green spaces that might have been ignored but as the map resolution was almost the same in the three maps, the comparison is realistic and possible.

As explained in chapter 2, this research does not follow the Iranian legal definition of a garden as a parcel more than $500\mathrm{m}^2$, having garden land use or garden deed. The history of the green fields in Tehran showed the dramatic decrease in the amount of green surface, and by taking into consideration the climatic conditions, water supply, air pollution issues and the still ongoing rapid urban expansion any single tree obtains a higher value. A tree itself may not have an ecological value but is an element to be used in the whole Tehran towards creating the green network; thus, a tree can bring an ecological value to the city. Green fields have to be preserved in order to be connected and make the green infrastructure of the city. However, without preserving the small elements there cannot be a thread of green to be spun together. The garden has been considered as an amount of trees and the city has been evaluated with its land cover and not the land use. This fact can be observed in the 2013 aerial photos; many green surfaces could be found which had no green land uses but the current surface of the parcel was green enough to be categorized as a garden. If the parcel had been taken as the base of the calculation in this study, the real surface area of the green fields in Tehran could not have been calculated. Many parcels are partially green and by taking the whole parcel in the calculations, buildings or non-tree yards would be included as well.

The second point is that if the urban planners see the map merely from the perspective of the urban plans and the plans are based on parcels, the contents of the parcels are being ignored. The plans had been produced when there was no access to the high-quality aerial photos and many of the land uses in the plans had to be generated by field surveys and staff presence in the regions. As a result, the residential, green space or commercial land uses could be written in the tables without knowing the exact texture inside the parcels. Many of the parcels which have been categorized as residential have a considerable amount of green and trees which put

Figure 5.7: Region1 green lands in 2013

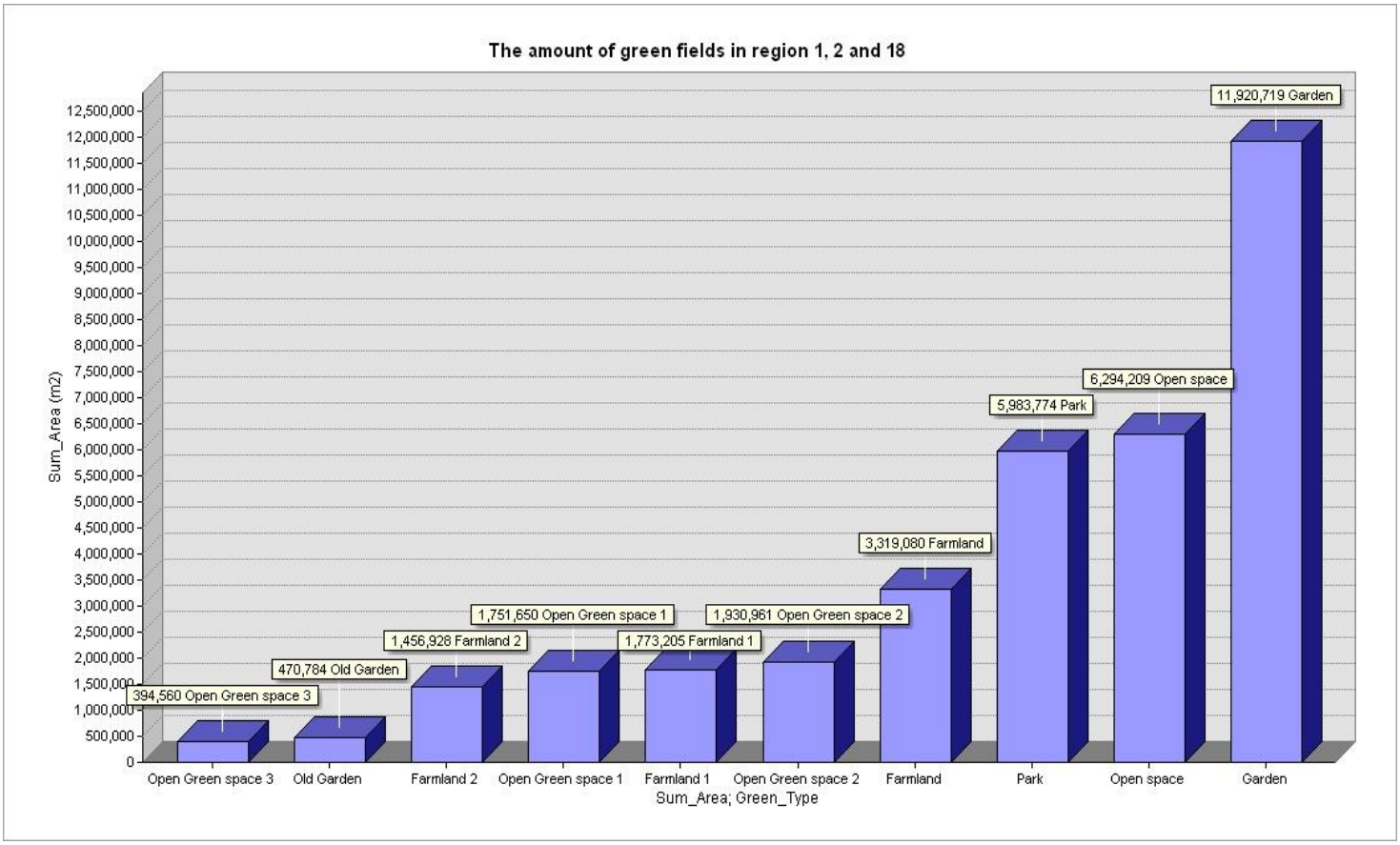


them in the list of gardens in this study. Therefore, it has been tried to overlay the previous aerial photos, new high resolution ones, Google earth and Detailed plans in one map and by turning the layers on and off, the type of each green surface has been determined. This group does not depend on the Detailed plan but has considered its land use and simultaneously paid attention to the real land cover.

Since the trees along the streets have fixed places and ownership, they have not been taken into calculations of this study. Nonetheless, there have been some cases, mostly in region 1, where the street trees where connected to a big green parcel and due to the importance of massive green zones and networking, they have been included in the calculation. The parks have been selected according to their name tagged on Google earth, the land use in the Detailed plans and their forms, elements and designs in the aerial photos.

Figure 5.6 shows the amount of different green fields in the selected case study regions in 2013. There have 10 different green field categories been distinguished according to their surface areas in the three selected regions. Thus, in the following part the green surface qualifications of the chosen case study regions will be explained and analyzed by using 2013 aerial photos. Each of these types has been defined according to the basic theories of the current research.

Figure 5.6: Different types of green fields in the selected regions of Tehran in 2013

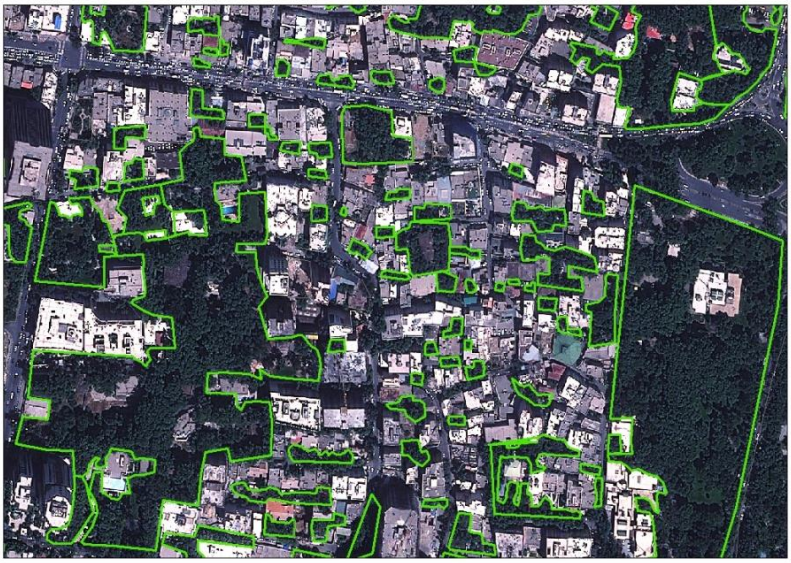


Source: GIS analysis by the author according to 2013 aerial photos- Bafte-e- Shahr Consulting Company

Despite all the green fields' destructions, region 1 is still the greenest region in 2013 with more than 8,000,000m^2 of the garden areas in the new definition (Figure 5.7). "Gardens" are the amount of trees and sometimes as small as a tree; therefore, the main important element is to have a tree which is massive. Figure 5.8 shows the examples of different groups of green fields and the green/orange lines show how each group has been selected. As explained above, the trees' area will be calculated even inside the parcels and the parcel boundaries do not play a role in defining the limits of the green surface.

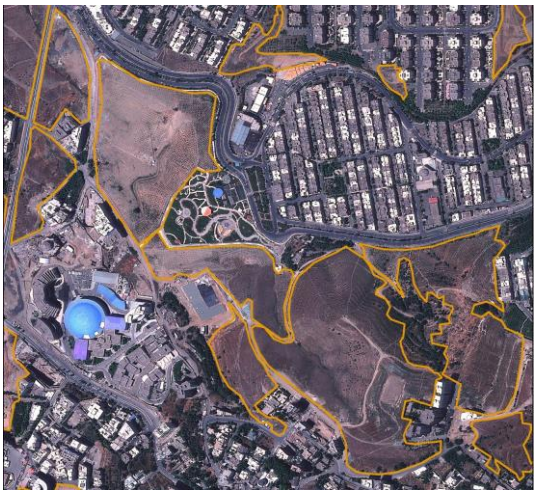
Figure 5.8: The examples of different types of green fields in the study

Gardens in east part of region 1



Green Open Space 1 in west of region 1

Open Space in region 1



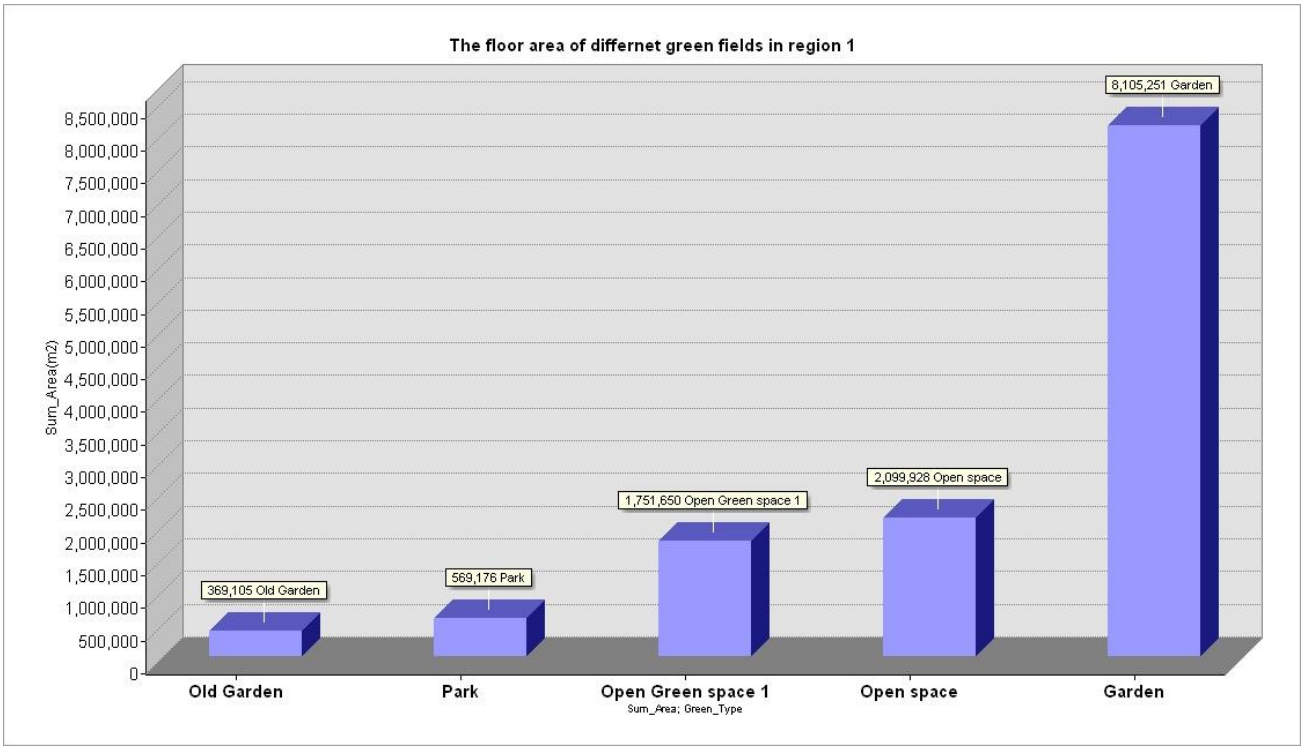
Old garden in region 1

Source: GIS analysis by the author

The second category contains what is called “open space” in this research. Open space is a piece of land often without walls which has been left abandoned or vacant and looks like distressed land. There is no visual building or green element on its surface, and it can be both potential and threat; a potential for the new green space expansions inside the compact, dense urban textures to complete the green network of the city or a threat if it is going to be used as a tool in infill development to conduct new constructions inside the city. It can be advantageous in TDR[1] procedure to lead the developments to the planned, suitable, non-green parcels and outside the green fields. By comparing the aerial photos with the Google map, it has been tried to avoid the open spaces on the high hills and to consider topography as a factor in choosing the open space (Figure 5.8).

The third category is “Open Green Space” which is in total according to their qualities divided into 3 different categories. However, in general, this group is in between garden and open space but contains mainly parcels without walls as is with open space. It does not have the massive group of trees as gardens do but it is not a vacant land like the open space either. Open Green Space 1 has the best quality (Figure 5.8) and quantity of trees and is mainly observed in region 1 (Figure 5.9).

Figure 5.9: Different kinds of green fields in region 1 in 2013



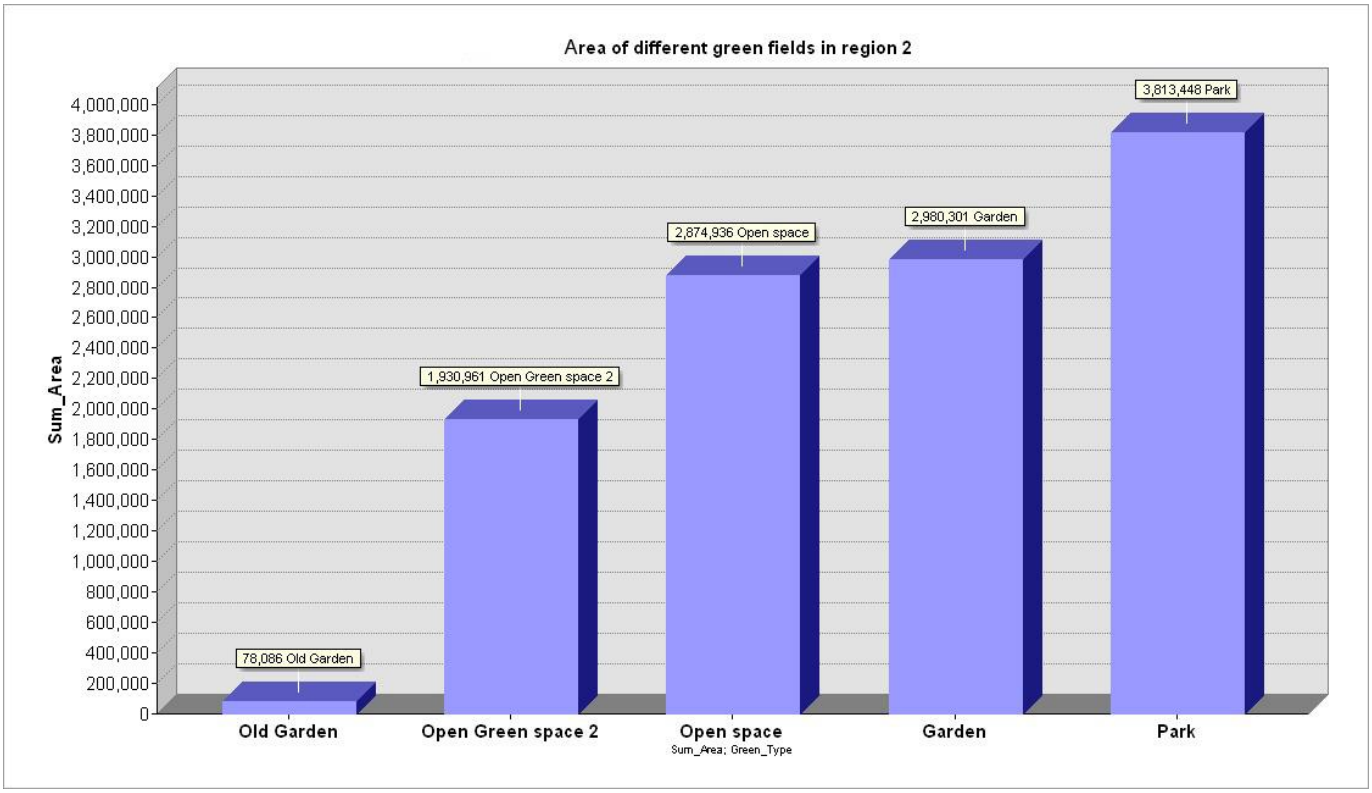
Source: GIS analysis by the author according to 2013 aerial photos- Bafte-e- Shahr consulting company

The forth group addressed as “Old garden” here refers to a garden parcel usually surrounded by walls without enough massive trees in the total surface area or in a certain part of it. In most of the cases it contains a building as a villa and is an example of the ecologically valuable gardens which have not been looked after by the owner for different reasons. Thus, they have often been rich gardens in the past and lost their trees during the time. This group is mostly found in region 1 (Figure 5.8).

Parks are the fifth group of the green fields in this study which are mainly found in region 2. Figure 5.10 shows different green categories in region 2, Pardisan Park (Figure 5.11) is a big parcel separating the northern and southern parts of the region along the main highways. However, this park has a poor green texture if compared to Jamshidieh Park in region 1 (Figure 5.12). This shows that the quality of the green texture inside the parks is different in the various regions. Parks in region 18 are more man-made and artificial whereas region 1 parks are the old natural gardens or palaces.

[1] Transferable Development Rights

Figure 5.11: Different kinds of green fields in region 2 in 2013



Source: GIS analysis by the author according to 2013 aerial photos- Bafte-e- Shahr consulting company

Figure 5.12: Different kinds of green texture/ quality of parks in region 1, 2 and 18 in 2013

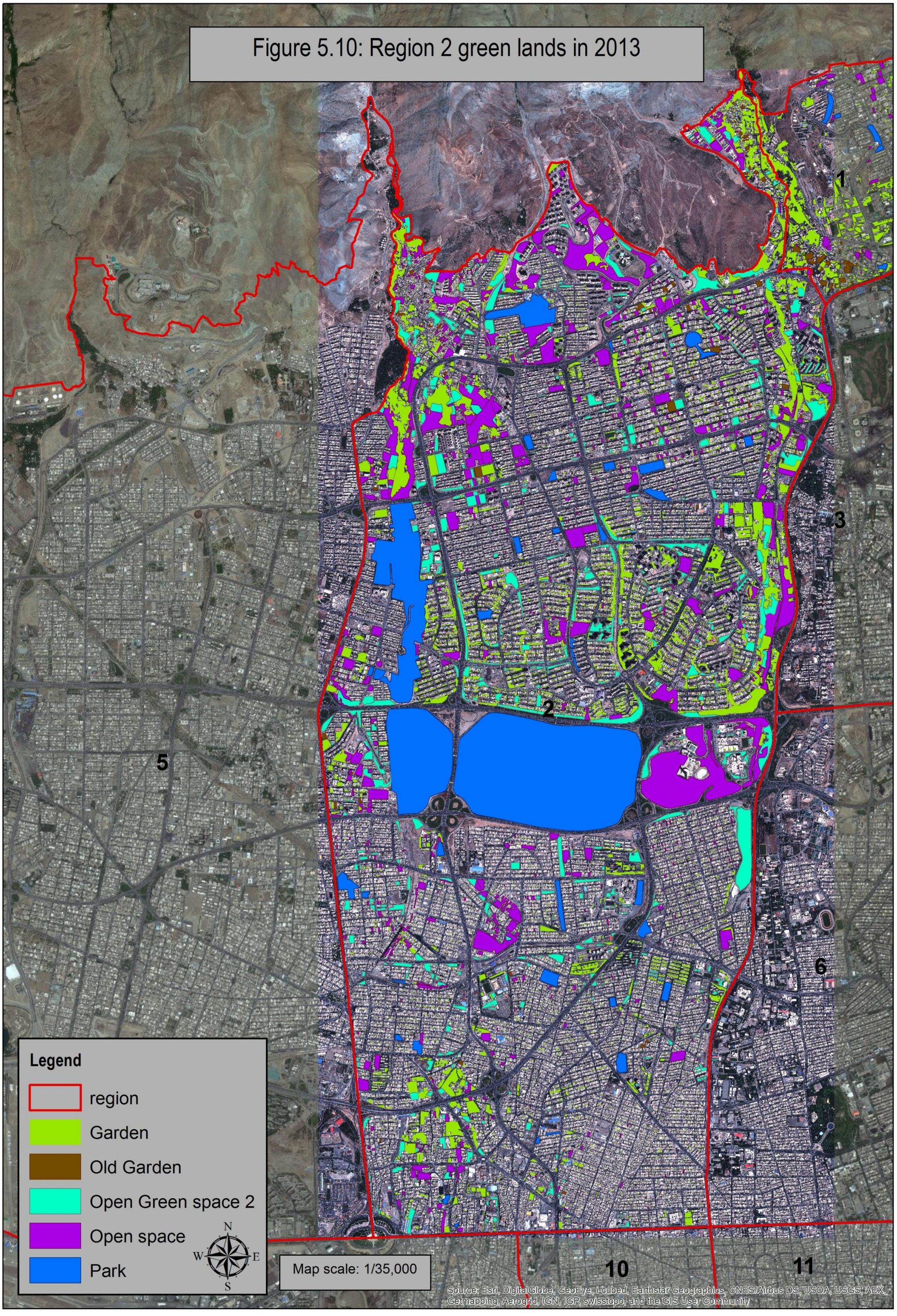
Pardisan Park in Region 2

Jamshidieh Park in Region 1

Ghaem and Banovan Park in Region 18

Source: GIS analysis by the author

Figure 5.10: Region 2 green lands in 2013



Open Green Space 2 has the same definition as 1 but the green texture and the quality of the green space is less than 1. This group is mainly concentrated in region 2 whereas in region 18 Open Green Space 3 is dominant. The ones in region 18 exhibit very dispersed trees and consequently have very low ecological value. By separating this group into 3 sub-groups their differences and consequently the relating policies can be well distinguished. Figure 5.13 shows the examples of these groups in a closer view.

Figure 5.13: Different kinds of open Green Space (top photos) and Farmlands (below photos) in 2013

Open Green Space 2 in region 2

Open Green Space 3 in region 18

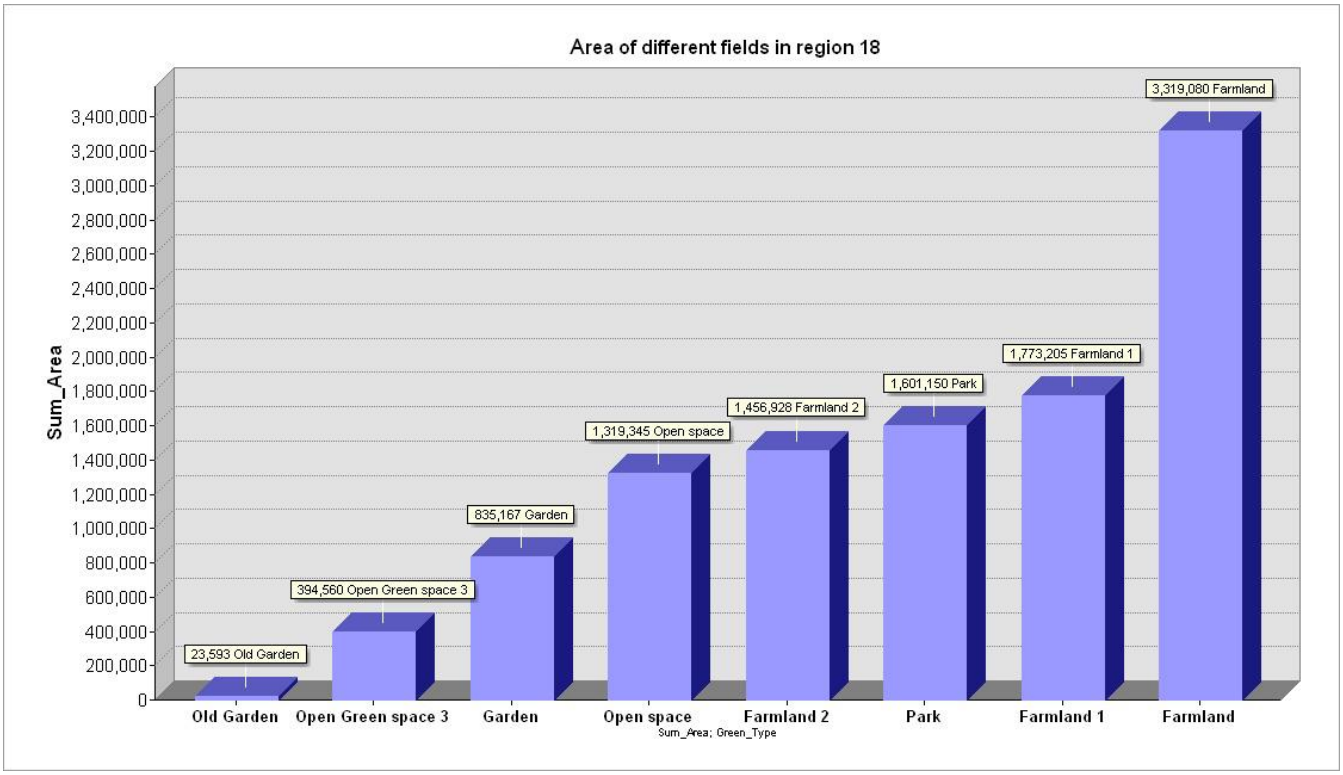
Farmland (red), Farmland 1(green), Farmland 2(yellow) in region 18

Source: GIS analysis by the

Region 18 is a farmland region (Figure 5.14). However, the differences between the quality of soil and crop are so that comprising all parcels in one cathegory would not be sufficient. As shown in figure 5.15, next to the green types that can also be found in other regions, region 18 comprises two categories of farmland (Figure 5.13). “Farmland” is the term used for the lands which cover the definitions mentioned in chapter 2, whereas “Farmland 1” is a very rich agricultural land with a green texture and a suitable soil. This land is very close to what US

Department of Agriculture defines as a prime farmland which is the best combination of physical and chemical characteristics for producing food. The last type of green fields in 2013 aerial photos is Farmland 2 which refers to parcels which show farmland as the land use in the Detailed plan, but the visual observation in aerial photos does not prove right. They look like open spaces or distressed lands, but as the Detailed plan has considered them as farmlands, they have to be taken into consideration. There can be different possibilities; either they have been farmlands between 2004-2007 when the Detailed plan has been produced and due to the lack of water, governmental support and negligence they have gradually turned into open spaces; or they are still farmland but due to technical considerations they have become fallow in order to recover for a year. Both cases show the quality of land use on these parcels differs from the others, and this is important for developing the policies. Therefore, Farmland 2 has been added to the categories.

Figure 5.15: Different kinds of green fields in region 18 in 2013

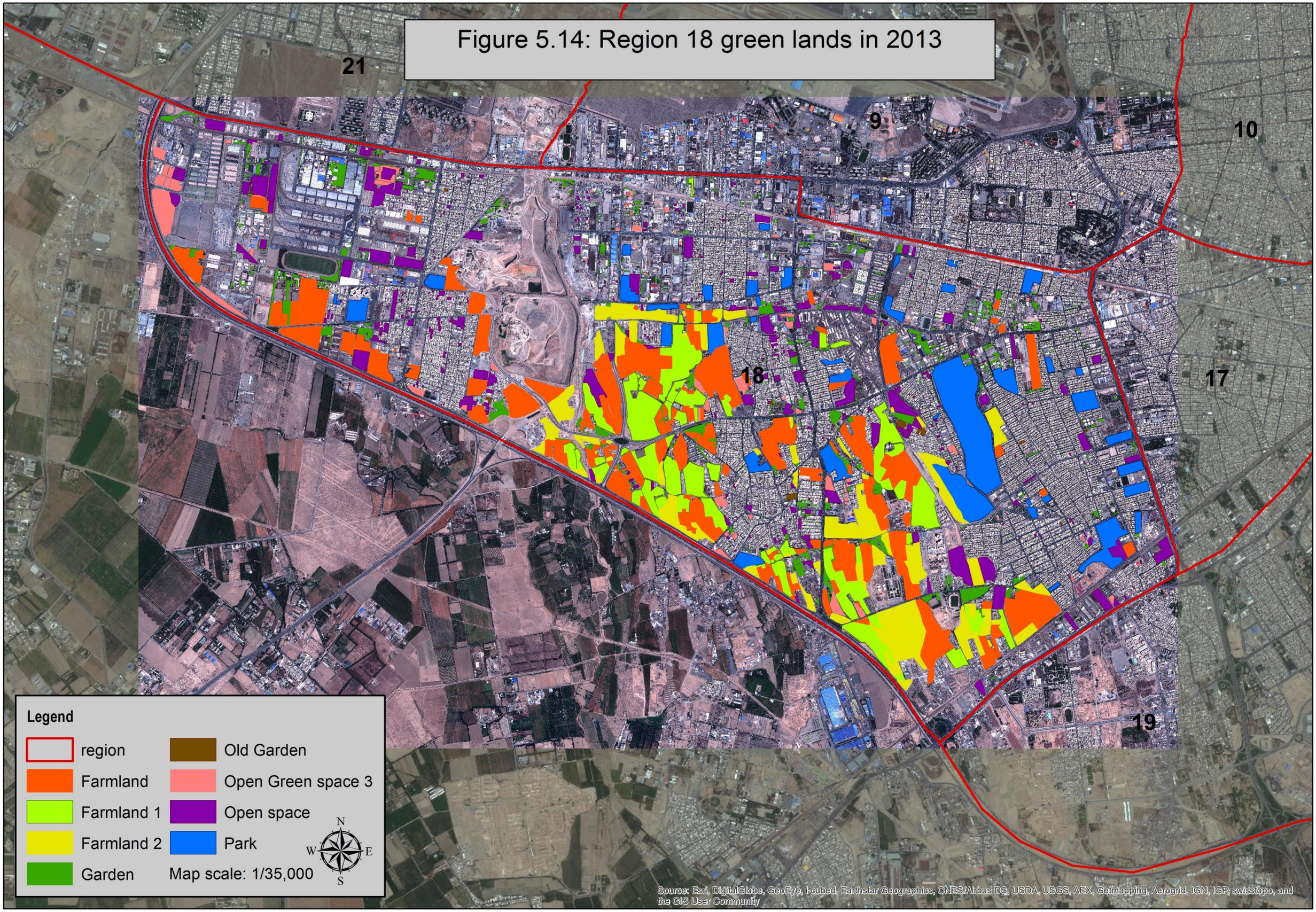


Source: GIS analysis by the author according to 2013 aerial photos- Bafte-e- Shahr consulting company

It must also be mentioned that there are many parcels in region 18 which have open spaces inside their surrounding walls. They are used are for stocks, transportation and industrial purposes. However, since they are potential open areas inside the city, they have to be taken into consideration in policy making. In terms of garden, park and trees in general region 18 is the poorest; thus, these parcels can compensate the lack of green space in this region. However, it should not be ignored that additional space for the factory, industrial and transportation uses will be required.

As a result, different green types have been defined and selected in the three selected case study regions. The results show different qualities and quantities of each category in each region. However, the same characteristics in each group make the comparison study and policy making easier in the further steps. Consequently, the maps produced consider these specific definitions which are based on the fundamentals in the theoretical basis of the research and also take into consideration the actual land cover and not just the conventional land uses in the urban plans.

Figure 5.14: Region 18 green lands in 2013

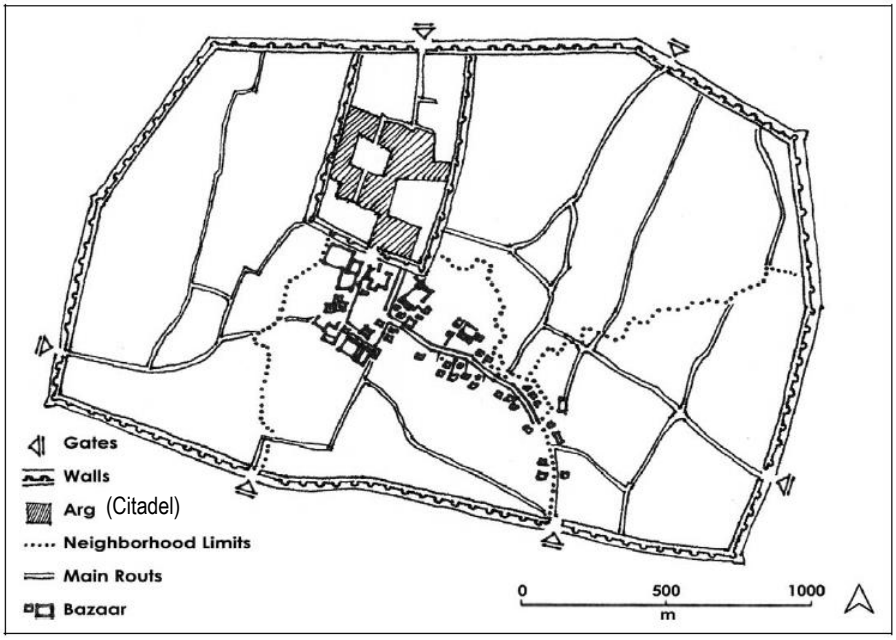


5.5 The history of Tehran urban plans

"The first phase of Tehran's planning refers to the period before the Second World War, whereby at least three major efforts set the framework for the city's growth and development: walling the city (1550s), expanding the walled city (1870s) and building a new urban infrastructure (1930s). They were all led by the government's ability and desire to instigate change and shape the city through undertaking large-scale infrastructure projects. The first large-scale town planning exercise in Tehran was undertaken in 1553, with the construction of a bazaar and city walls, which were square and had gates on four sides, in accordance with the pattern of ancient Persian cities (Barthold, 1984 quoted after Madanipour, 2006, p.433)." "This set the framework for other developments that followed, and the city grew in significance, eventually to be selected in 1785 as the capital of the Qajar dynasty (1779–1925) (after Madanipour, 2006, p.433)."

"The first development plan of Tehran in 1855 (Figure 5.16) emphasized the traditional spatial structure. Architecture, however, found an eclectic expression to reflect the new lifestyle. The main change in style was the deviation from the introverted orientation of traditional building. The new architecture is today referred to as shiveh-ye Tehrani (or the Tehran style), and served as a model for change in other cities (Vahdat zad, 2012, p.51)."

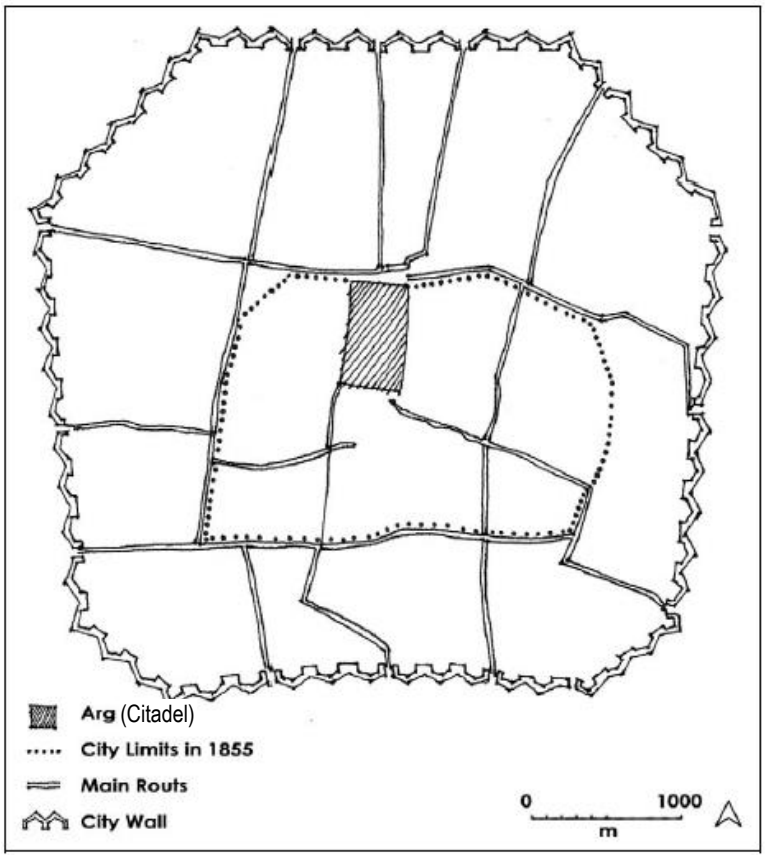
Figure 5.16: The first development plan of Tehran in 1855



Source: Vahdat zad, 2012, p.51

"The country's military defeats in its encounters with Britain and Russia had engendered a process of reform, which was now being extended to the capital city. The second large-scale town planning exercise in Tehran, therefore, was conducted for accommodating growth and introducing modernization and reform (Figure 5.17). Starting in 1868 and lasting for 12 years, new city walls, in the form of a perfect octagon with 12 gates, were constructed, which were more useful for growth management and tax collection than for their defensive value. Selection as the capital city and these transformations, which included a new central square, new streets, a bank, an institute of technology, a hospital, a telegraph house, hotels and European-style shops, were, according to a British observer, a ''twofold renaissance'' for Tehran (Curzon, 1892, p. 300 quoted after Madanipour, 2006, p.433)."

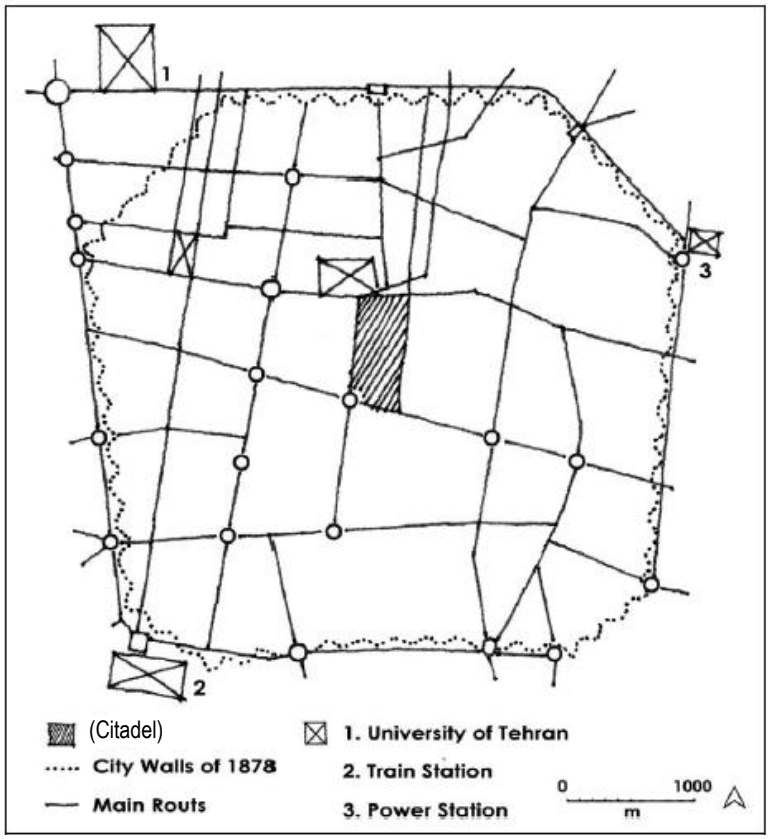
Figure 5.17: The second Development plan of Tehran- 1978



Source: Vahdat zad, 2012, p.52

After the first World War, the Pahlavi dynasty came to power and this lasted from 1925 to 1979. The new regime's emphasis was on secularism and nationalism, which were reflected in administrative centralization, modernization of the army, expansion of bureaucracy, development of a transport network, integration of the regions into a national market, and restructuring towns and cities (Abrahamian, 1982 quoted after Madanipour, 2006, p.434). "The 1930s witnessed widespread road-widening schemes that tore apart the historic urban fabric, making them accessible to motor vehicles (Figure 5.18). The city of Tehran thus went through its third major town planning exercise. The city walls of the 1870s were far too restrictive for a growing city. New boulevards were built on the ruins of the city walls and moats, as part of a transport network of 218 km of new roads. The walled royal compound was fragmented and replaced by a new government quarter; retailers were encouraged to move to new streets and to abandon the old streets of the bazaar; and new buildings and institutions sprang up all over the city. The new street network was imposed on the winding streets of old neighborhoods, with the aims of unifying the space of the city, overcoming the traditional factional social structure, easing the movement of goods, services and military forces, strengthening the market economy and supporting the centralization of power. The city was turned into an open matrix, which was a major step in laying the foundations for further modernization and future expansion. The immediate result was the growth of the city from 310,000 inhabitants in 1932 to 700,000 in 1941 (Madanipour, 2006, p.434)."

Figure 5.18: Tehran in 1937



Source: Vahdat zad, 2012, p.55

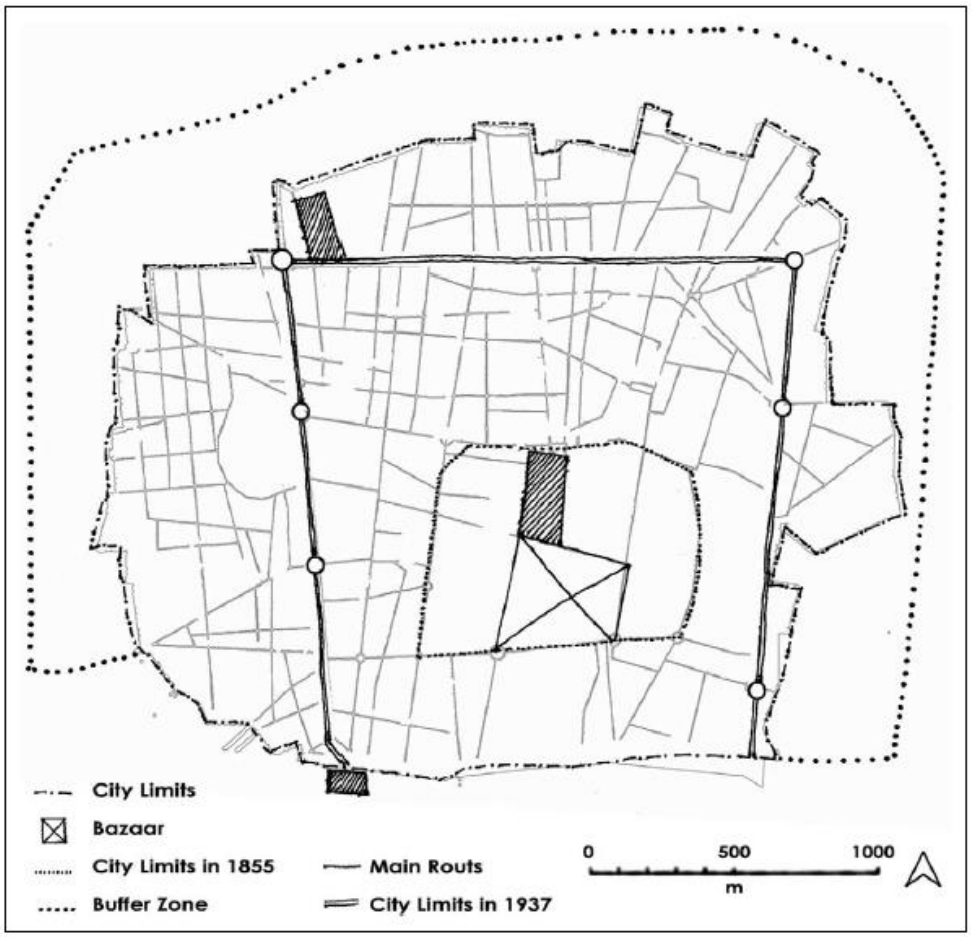
"These large-scale urban planning and development phases of Tehran were all efforts at modernization, instigating and managing radical change. However, while the first phase had used distinctively ancient Persian imagery and local expertise, the second and third phases employed European images and experts, primarily from France and Germany. What these early town planning efforts shared was that they were all envisaging a particular new form and implementing it through the (re)development of the urban environment; they were all plans for a major series of physical changes executed in a relatively short period of time (Madanipour, 2006, p.434)." "The establishment of the planning organization of Iran in 1948 resulted in the first socioeconomic development plan to cover 1949 to 1955. The highly sectoral and vertical administration of planning along with the concentration of industrial investment in a few regions accelerated the uneven and rapid growth in central cities of some major provinces, especially in Tehran as shown in figure 5.19 (Vahdat zadeh, 2012, p.56)."

The second type of planning to emerge in Tehran was in the 1960s, which saw the preparation of plans to regulate and manage future change. The city had grown in size and complexity to such an extent that its spatial management needed additional tools, which resulted in the growing complexity of municipal organization, and in the preparation of a Comprehensive plan for the city. An industrialization drive from the mid-1950s created many new jobs in big cities, particularly in Tehran. The land reforms of the 1960s released large numbers of rural population from agriculture, which was not able to absorb the exponential demographic growth. This new labor force was attracted to cities: to the new industries, to the construction sector which seemed to be always booming, to services and the constantly growing public sector bureaucracy (Madanipour, 2006, p.434).

"The city grew in a disjointed manner in all directions along the outgoing roads, integrating the surrounding towns and villages, and growing new suburban settlements. This intensified social segregation, destroyed suburban gardens and green spaces, and left the city managers feeling powerless. A deputy mayor of the city in 1962 commented that in Tehran, ''the buildings and settlements have been developed by whomever has wanted in

whatever way and wherever they have wanted'', creating a city that was 'in fact a number of towns connected to each other in an inappropriate way' (Nafisi, 1964, p. 426 quoted after Madanipour, 2006, p.435)."

Figure 5.19: Tehran in 1953

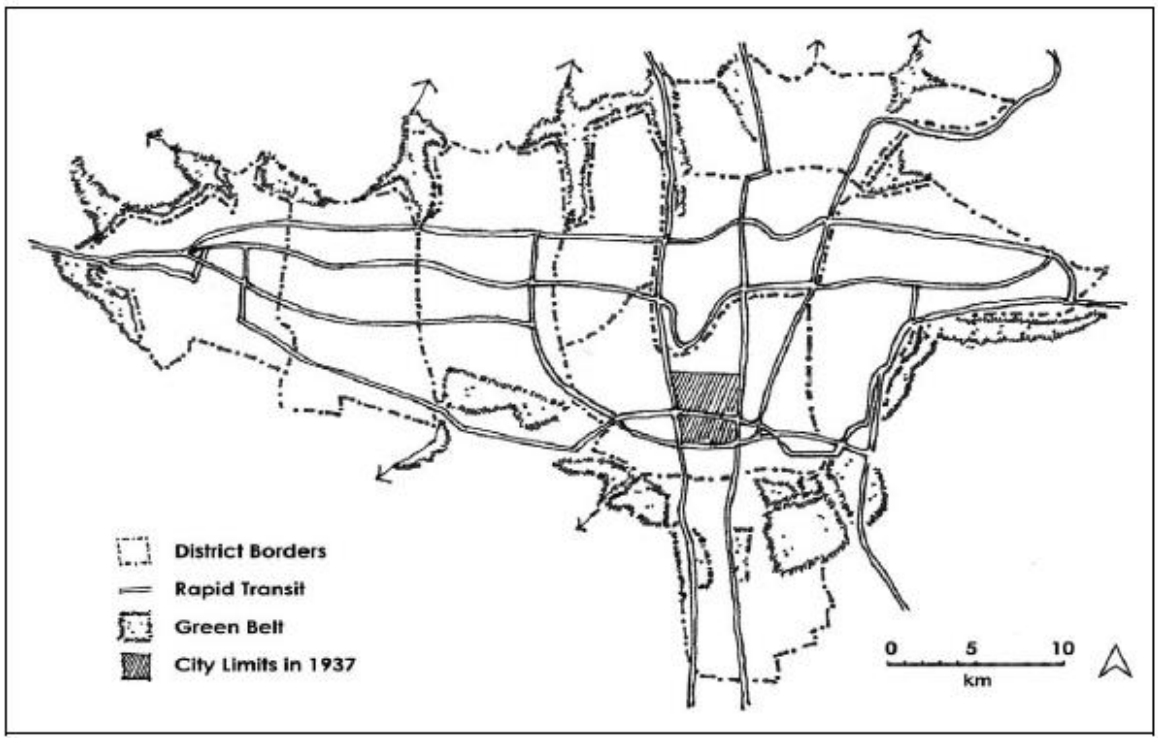


Source: Vahdat zad, 2012, p.56

"The 1966 Municipality Act provided, for the first time, a legal framework for the formation of the Urban Planning High Council and for the establishment of land-use planning in the form of Comprehensive plans. A series of other laws followed, underpinning new legal and institutional arrangements for the Tehran municipality, allowing the Ministry of Housing and others to work together in managing the growth of the city. The most important step taken in planning was the approval of the Tehran Comprehensive plan in 1968 (Figure 5.20). It was produced by a consortium of Aziz Farmanfarmaian Associates of Iran and Victor Gruen Associates of the United States, under the direction of Fereydun Ghaffari, an Iranian city planner (Ardalan, 1986 Quoted after Madanipour, 2006, p. 435)." The plan had a concept of Tehran linear expansion because of the natural-geographical limitations of Tehran (Figure 5.21). In the north the mountains did not let the city expand its boundaries and in the south the bad severe climate conditions. "The plan identified the city's problems as high density, especially in the city centre; expansion of commercial activities along the main roads; pollution; inefficient infrastructure; widespread unemployment in the poorer areas, and the continuous migration of low-income groups to Tehran. The solution was to be found in the transformation of the city's physical, social and economic fabric. The future of the city was envisaged to be growing westward in a linear polycentric form, reducing the density and congestion of the city centre. The city would be formed of 10 large urban districts, separated from each other by green belts, each with about 500,000 inhabitants, a commercial and an industrial centre with high-rise buildings. Each district (mantagheh) would be subdivided into a number of areas (nahyeh) and neighborhoods (mahalleh). An area, with a population of about 15–30,000, would have a high school and a commercial centre and other necessary facilities. A neighborhood, with its 5000 inhabitants, would have a primary school and a local commercial centre.

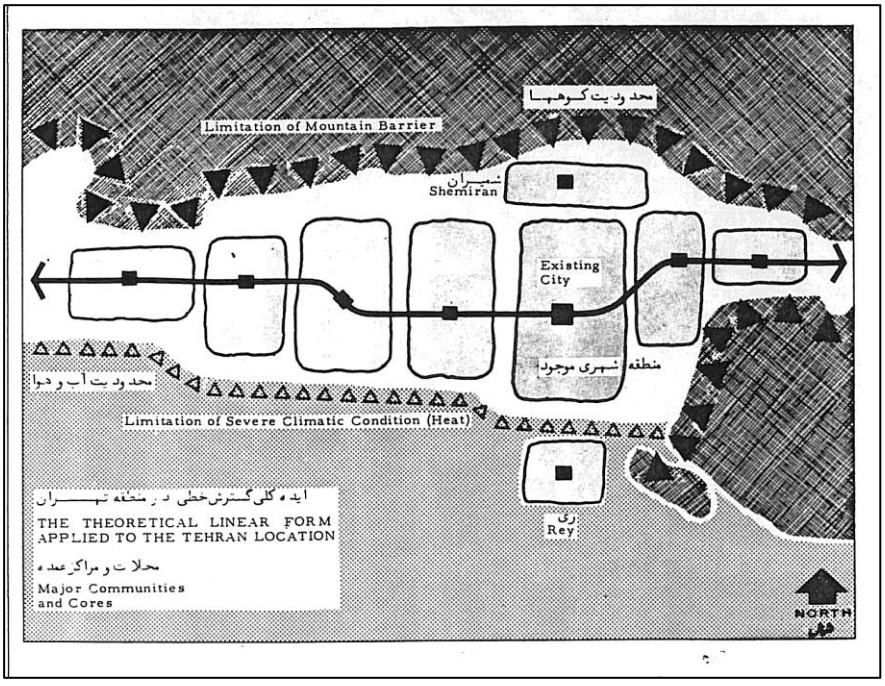
These districts and areas would be linked by a transportation network, which included motorways, a rapid transit route and a bus route. The stops on the rapid transit route would be developed as the nodes for concentration of activities with a high residential density. A number of redevelopment and improvement schemes in the existing urban areas would relocate 600,000 people out of the central areas (Farmanfarmaian and Gruen, 1968 quoted after Madanipour, 2006, p.435). Figure 5.22 shows the land use of this Comprehensive plan.

Figure 5.20: The 1968 Comprehensive plan of Tehran



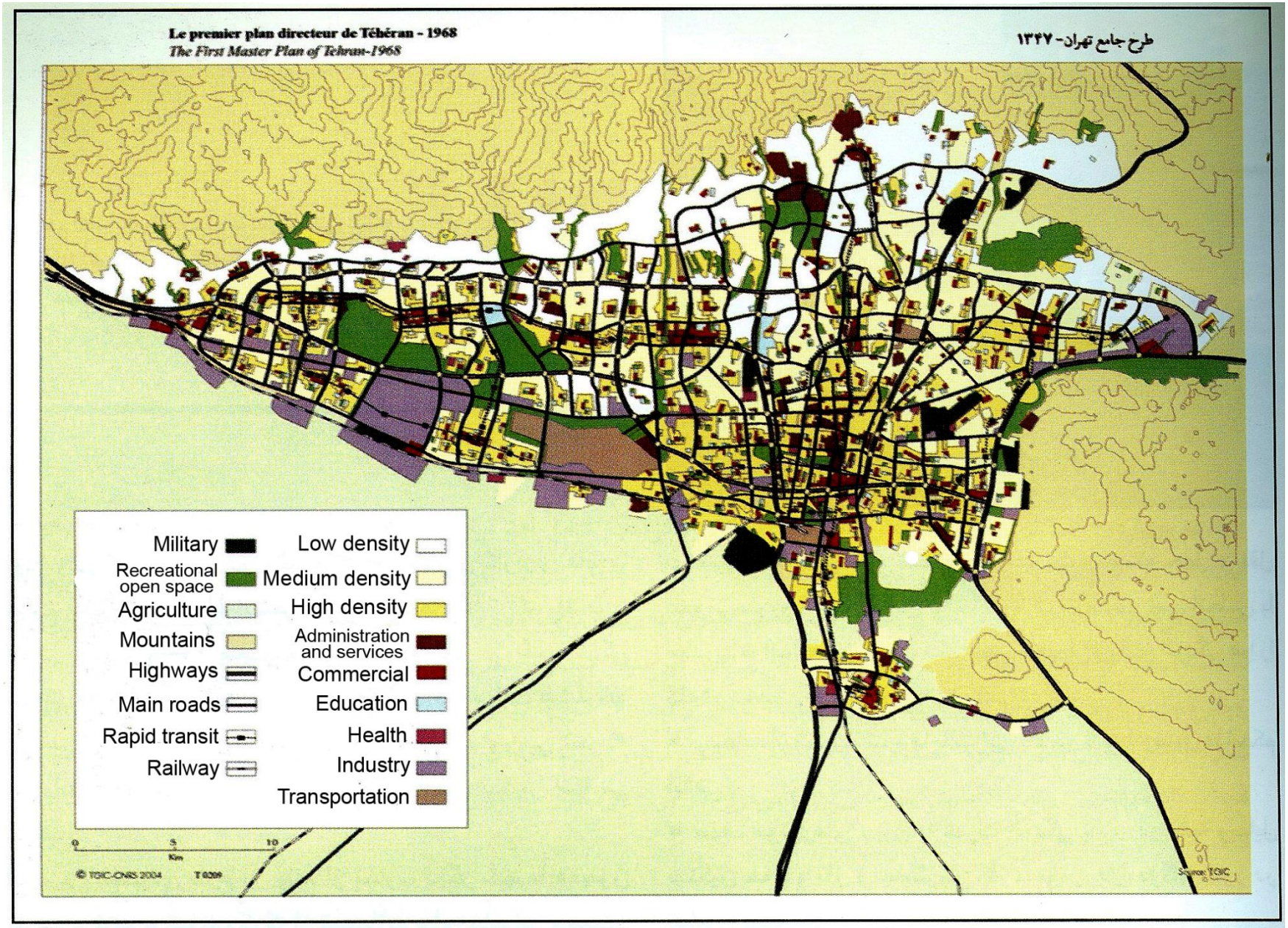
Source: Vahdat zad, 2012, p.58

Figure 5.21: The linear expansion of Tehran as the main concept of 1968 Comprehensive Plan



Source: ATEC Consulting Company, 2014

Figure 5.22: Land use Plan of the 1968 Comprehensive Plan



Source: Ghaffari, 2006, p.27

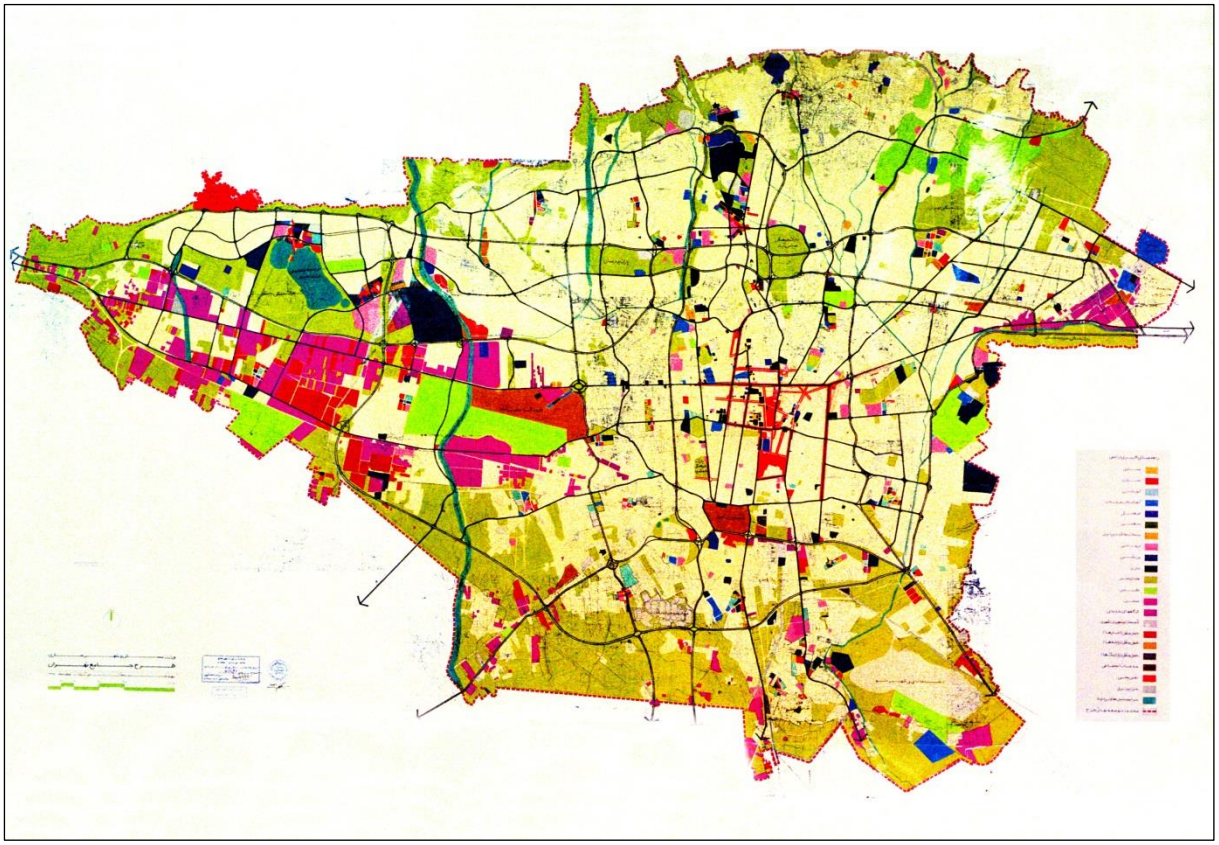
“Almost all these measures can be traced to the fashionable planning ideas of the time, which were largely influenced by the British New Towns. In his book, The Heart of Our Cities, Victor Gruen (1965) had envisaged the metropolis of tomorrow as a central city surrounded by 10 additional cities, each with its own centre. This resembled Ebenezer Howard’s (1960, p. 142) ‘‘social cities’’, in which a central city was surrounded by a cluster of garden cities. In Tehran’s plan, a linear version of this concept was used. Another linear concept, which was used in the British New Towns of the time such as Redditch and Runcorn, was the importance of public transport routes as the town’s spine, with its stopping points serving as its foci. The use of neighborhood units of limited population, focused on a neighborhood centre and a primary school, was widely used in these New Towns, an idea that had been developed in the 1920s in the United States (Mumford, 1954). These ideas remained, however, largely on paper. Some of the plan’s ideas that were implemented, which were rooted in American city planning, included a network of freeways to connect the disjointed parts of the sprawling metropolis; zoning as the basis for managing the social and physical character of different areas; and the introduction of Floor Area Ratios for controlling development densities (Madanipour, 2006, p.435).”

“After the revolution and war, a period of normalization and reconstruction started, which lasted for most of the 1990s. This period witnessed a number of efforts at urban planning in Tehran. Once again, urban development had intensified without an effective framework to manage it. The Comprehensive plan came under attack after the revolution, as it was considered unable to cope with change. In 1998, the Mayor criticized it for being mainly a physical development plan, for being rooted in the political framework of the previous regime, and for not paying enough attention to the problems of implementation (Dehaghani, 1995 quoted after Madanipour, 2006, p.436).”

“The Comprehensive plan’s 25-year lifespan came to an end in 1991. A firm of Iranian consultants (A-Tech) was commissioned in 1985 to prepare a plan for the period of 1986–1996. After much delay, it was only in 1993 that the plan was finally approved by the Urban Planning High Council (Figure 5.23). This plan also focused on growth management and a linear spatial strategy, using the scales of urban region, sub-region, district, area and neighborhood. It promoted conservation, decentralization, polycentric development, development of five satellite new towns, and increasing residential densities in the city. It proposed that the city be divided into 22 districts within five sub-regions, each with its own service center (Shahrdari-e Tehran, 2004 quoted after Madanipour, 2006, p.436).”

The 1993 plan was not welcomed by the municipality, which disagreed with its assessments and priorities, finding it unrealistic, expensive, and impossible to implement. The municipality produced its own strategic plan for the period 1996– 2001, known as Tehran Municipality’s First Plan, or Tehran 80. Rather than introducing a land-use plan as its goal, this was the first plan for the city that emphasized a set of strategies and proposed policies to achieve them. It identified the city’s main problems as shortage of resources to deliver its services; the pace and pattern of urban growth; environmental pollution; the absence of effective public transport, and inefficient bureaucracy. The municipality’s vision for the future of the city was then outlined to have six major characteristics: a clean city, ease of movement in the city, the creation of parks and green spaces, the development of new cultural and sports facilities, reform of the municipal organization, and planning for the improvement of urban space, including preparation of comprehensive and Detailed plans for land use and conservation (Shahrdari-e Tehran, 1996 quoted after Madanipour, 2006, p.436).

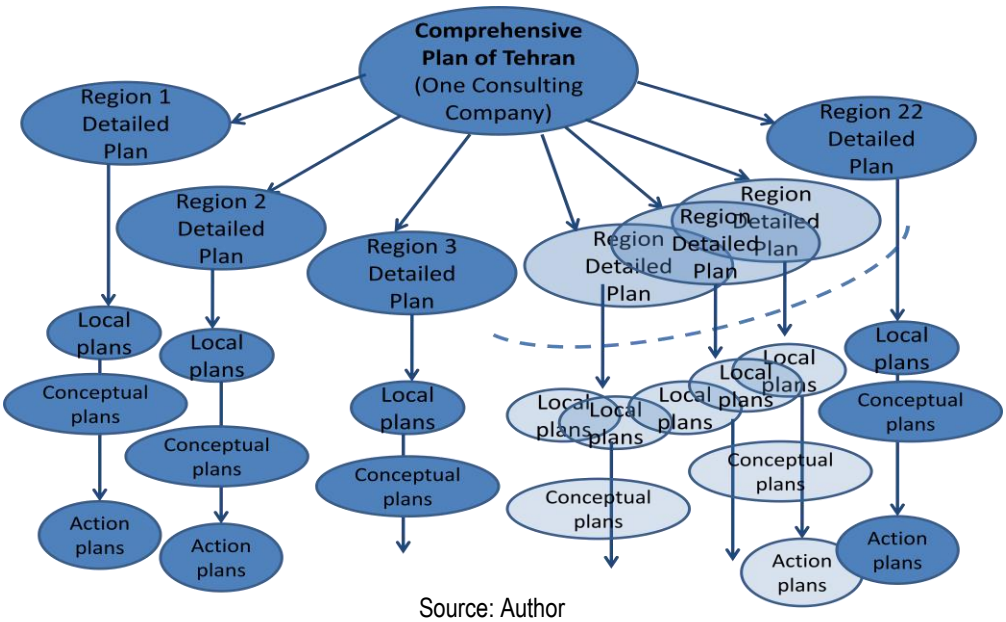
Figure 5.23: ATEC Master Plan, 1992



Source: ATEC Consulting Company, 2014

Therefore, the preparations of providing the Comprehensive plan for Tehran were ready. Since 2002, shortly before the Comprehensive plan being produced, for any urban region a "Development Pattern plan" has started being prepared. From each Development Pattern plan each region Detailed plan has been derived by an urban consulting company. This is a complete urban document for the future of the region. From each Detailed plan, local and conceptual plans have been produced in order to realize the action plans for the further steps (Figure 5.24). Here, Tehran urban plans containing the Comprehensive plan, the Detailed plans of the selected regions for this study (region 1, 2 and 18) will be reviewed and the approach of each urban plan regarding the green lands in each Tehran region will be clarified.

Figure 5.24: The urban plan system in Tehran



Source: Author

5.6 Tehran Comprehensive plan 2007 approach concerning green lands[1]

In this section the parts of the Comprehensive plan of Tehran regarding green lands and preservation have been selected and translated.

5.6.1 Tehran Comprehensive plan visions

The long term vision of the Tehran development has an indirect correlation with the general 20 years country vision and is based on the following objectives:

- Tehran: a city with Iranian –Islamic identity
- Tehran: a knowledge based, smart and global city
- Tehran: a beautiful green city, alive, fresh and creative with diverse and widespread public spaces
- Tehran: a safe city resilient to natural hazards and accidents
- Tehran: a sustainable, solid city with an appropriate structure for accommodation, activity and leisure
- Tehran: a fluid city in regard to public welfare and sound infrastructure, balancing inequalities and providing all urban-citizen rights
- Tehran: A metropolitan with national and international functions together with modern economy, the center of cultural –researched based and political activities across the country and at least one of the three most important cities in south –west Asia.

5.6.2 City development approaches

To start explaining the main approaches followed by the Comprehensive plan in the field of urbanism, the current land uses of Tehran are presented as follows (Table 5.9).

Table 5.9: Current main land uses in Tehran according to Comprehensive plan 2006

Land use	Area	Percentage
Residential	177	28.5
Commercial-Administrative	26	4.2
Industry	27	4.3
Transportation and Warehouse	30	4.8
Urban Services	50	8.1
Green Spaces	70	11.3
Agricultural and Gardens	35	5.6
Military	49	7.9
Access Network	114	18.4
Non built and etc.	43	6.9
All Land uses	621	100

Source: Tehran Comprehensive plan (2006)

There are the following approaches:

-Upgrading city quality and preserving the city limits and preventing any excessive urban development as followed: preventing the metropolitan sprawl and stabilizing Tehran boundaries from North, South, east and West; Tehran boundary is the physical limit of the capital and Tehran municipality is obliged to specify the city boundaries with specific fixed signs especially on the northern frontier, in addition to inform the authorities of any

[1] In this part the exact translation of the related parts of the original urban plans will be presented and at the end of each plan the author's analysis and ideas will complete the whole discussion.

breach of these city limits/regulations; Tehran municipality is obliged by law to preserve the city effectively, give it the identity and also create the city greenbelt parallel with the confirmed city boundaries in the form of green land uses (forest and urban parks, fruit and non fruit gardens); districting the residential construction development close to the city limits and allocating the lands near the city borders to special functions such as leisure, tourism and multifunctional purpose land uses with least occupancy space (construction space), density and destroying green-open spaces.

- Preserving the boundaries of the capital city by: Setting laws and comprehensive regulations for all "Population and Activity Centers" in the city of Tehran through the boundary plans in the Comprehensive plan; serious confrontation with any construction breach or any informal and illegal settlements including private or public sectors which own big land plots inside or close to the city boundaries.

- Elevation of Tehran Status in national and regional and international scales.

- Social development and improvement of mass accommodation explained as followed: Tehran population with its natural growth and statistical analysis of 2006 is estimated 8.7 million people for plan vision (2026). Therefore, the urban service planning for residents and employed population is based on 9.1 million people. Accommodation capacity based on 20% more than the predicted population in 20 years (planning horizon) is estimated as 10.5 million people; final area confirmation of net residential land use is 180 km^2; appropriate distribution of population in the big city through accommodation status elevation in a way that the mean per capita reach at least to 17.5 m^2.

- Economic Development and prosperity Tehran activities: The sustainable budget substitution for urban management expenses with the gradual decrease in budget share from residential construction (selling construction density); prevent land speculation and non productive jobs in land market and housing; providing sustainable space for technology corridors (knowledge and technology parks and IT complex buildings) and using the preferred zones for specialized branches of research and knowledge agencies; substituting the current polluting large industries with small to medium size industries according to regulations

- Improving the transportation network and traffic system: Developing the public transportation system especially railway with the top priority of monorail based on economic and technical studies; improving highway network inside and outside of Tehran with emphasis on modifying hierarchic access network inside the city to achieve a comprehensive integrated transportation system in Tehran Metropolitan Region[1]; adjusting the city roads, circulation and access for disabled people; facilitating the pedestrian and bicycle circulation in historical zones inside Tehran; equip metro stations with new technology to achieve ICT development and electronic city; reduce inner city and around inner ring car traffic with special policies to increase parking plots; public parking constructions in the main station with direct access to west and east; preventing municipalities and certain regulations "Committee Code 100 " from collecting fines instead of building parking spaces (to issue building permit); building substitute parking areas in the places with insufficient space.

- Environmental Preservation**:** Guarantee of the preserved zones' sustainability and ecosystem diversity, garden preservation and development of the agricultural lands and green spaces in the city and the Metropolitan region of Tehran; Transferring the polluted centers and loading terminals outside of the city**;** Optimizing waste management especially dangerous hospital waste and construction rubble and implementing new methods of garbage disposal/burial (management) with the least damage to environment.

- Resistance to natural disasters (earthquakes, floods)
- Improving natural hazard management and passive defense in Tehran
- Providing the sufficient water supply, equip water and sewage network and upgrading riverbed quality
- Improve and elevate physical condition of Tehran (Tehran spatial organization)

[1] Tehran Metropolitan Region or Tehran Functional Urban Region is used for the City of Tehran and 13 towns around it ,30 districts and 50 municipalities with 1600 Km^2. Tehran Metropolitan has 1200 village centers and 400 of them have independent management system.(Asadi and Zebardast , 2010, Tehran)

- Urban environment efficiency elevation with allocating zones and supervising constructions of various land uses: Setting incentive policies to decrease the built area in all the constructions; Supervising the standard legal density for residential buildings and setting suitable policies to increase density in the mixed used and activity zones.
- Active preservation[1] of the natural historical and cultural heritage: Mountain preservation through greenbelt and controlling land allocation near the mountains and the city borders; Natural water stream preservation in the city and creating attractive recreational spaces on the river banks; Preserve and develop the gardens, natural parks, urban parks (Lavizan, Gazal, Sorkhehesar, Abbasabad, Pardisan and Chitgar) and natural-historical zones in Bibishahbanou and Cheshme ali.

- Elevation of the image of Tehran identity through urban design to revive Iranian-Islamic architecture and urbanity

- Development of green recreational public spaces: Green spaces development in urban, regional, district and local scale to provide at least $10\mathrm{m}^2$ green space per capita in Tehran; Protect and utilize the natural parks potentials according to "Forest Protection and Utilization with Function Elevation Approach" law to turn these features to suitable places for leisure, play, sport, entertainment, tourism and hazard management; improving riverbeds quality especially Kan River as a north-south urban green corridor; allocating certain zones in the city to leisure and tourism especially north–east, east and south border (Bibishahbanou) and region 22; proving suitable service to elevate the required service for tourism industry and site selection for accommodation and tourist reception centers with international standards

- Providing needs and elevating urban services in Tehran: Increasing urban services per capita of the following land uses such educational, health, cultural, religion, sport, tourism services and urban infrastructure up to 2 times more than status quo until the plan horizon (approximately 13 m^2in addition to green spaces).

- Rehabilitation, renewal and renovation of urban distressed area in Tehran

5.6.3 Tehran spatial organization and zoning

In this section of Master plan, Tehran is divided into 5 North-East corridors and 3 East-West corridors which facilitate the city circulation. Spatial organization has been designed with decentralization and hierarchic system with these sets of centers: City centers and beyond city centers, city centers with urban and regional functions, city centers with regional, district and local function.

Tehran zoning structure in Comprehensive plan is based on 4 different zones: accommodation, activity, mixed use, preservation (open and green spaces). "Accomodation Zone": with 266 km^2 is mostly used as residential land use. Except this land use, road network, accessibility and service supporting residential land use is also included. " Activity Zone" with 182 km^2 is mostly occupied with work and activity buildings. Residential blocks are limited in this zone and are related to activity. "Mixed use "with the area of 47 km^2 has the potential of locating mixed land uses such as work, activity, accommodation and etc. "Preservation Zone" (open and green spaces) with 107 km^2 is composed of green-open public and private spaces, natural parks, gardens and agricultural lands and also protection zones. In these zones according to law and regulations any construction is forbidden or very limited. (G) indicates this land use.

Another point mentioned in this part is using the large undeveloped spaces and remaining open spaces and also rehabilitation of urban distressed areas for developing urban infrastructure, utility, green spaces, public spaces, leisure, cultural services and activities. Table 5.10 and figure 5.25 show the Comprehensive plan zoning. All the activities in Tehran have been categorized to main land uses and from this level converted to one of the mentioned zones. The zoning method is based on LBCS[2] and ISIC.[3]

[1] Active Preservation is described as followed in the Comprehensive plan: is a kind of preservation based on high protection, physical improvement and registering the parcel activity in city database systems.
[2] Land – Based classification standards
[3] International standard industrial classification of all Economic Activities

Table 5.10: Tehran Comprehensive plan zoning

Zones	Main zones		Subzones
Accommodation (R)	Residential	R1	Residential zones with low, medium and high density
	Special residential	R2	Valuable village, historical, garden-residential homes
Activity (S)	Commercial or administrative land use and services	S1	Traditional Bazars[1] and commercial corridors
	Service, administrative and commercial (special activity)	S2	Plots with green and open spaces
	Industrial and workshop	S3	Company and service industry
Mixed (M)	Residential and activity	M1	Residential with service, administrative, commercial and service industry
	Special Mixed land use(leisure and tourism)	M2	North and East mountains
Preservation (open and green) (G)	Green and open public spaces	G1	Urban and natural parks
	Garden and agriculture	G2	Urban gardens and agricultural

Source: Tehran Comprehensive plan (2006)

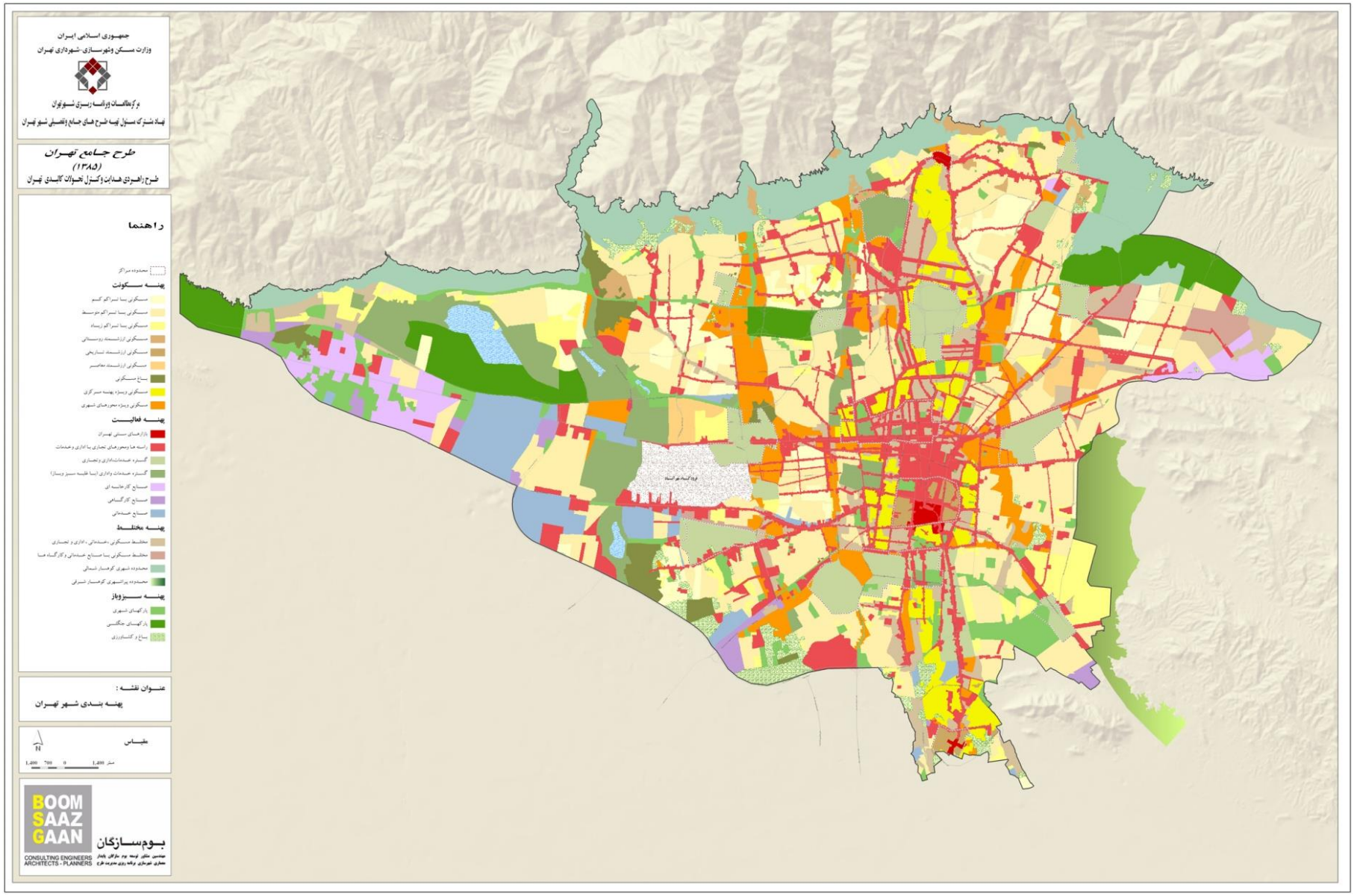
5.6.4 Construction regulations and land allocation

The highest allowed density in Detailed plan stretches from 80 % to 440% (except high rise zones). Allowed building density in preservation subzones (green and open spaces)(G), special mixed (M22), industrial clusters (S311), commercial centers, service, administrative zones (with cluster approach)(S22), Bazar (S11) and high rise zones plan must be approved in "Committee code 5".

In the Comprehensive plan high-rises are defined as the buildings with 12 stories or more which can only be built in high rise zones that are not endangered by earthquakes. From this date on high rise construction or issuing any construction permission by municipality for high rises in all Tehran zones with any land use is not allowed.

[1] Bazar is a term used for traditional Iranian (eastern) market. Bazar has been always the core and an element of Iranian cities' spatial organization.

Figure 5.25: Tehran land use zoning in The Comprehensive plan 2007



Source: Tehran Comprehensive plan –Boomsazegan Consulting Company-2006

5.6.5 Conceptual and local development plans in Tehran

18 conceptual plans and 78 projects have been presented in the Tehran Comprehensive plan. Local and conceptual plans regarding green spaces, gardens and the research content are as follows:

Local plans:

-Improving Darband –Ray urban corridor (Region1 to south)

-Improving Darake urban corridor (region 1)

-Improving Darband –Bibishahbanou urban corridor (Region 1 to East)

-Improving Farahzad urban corridor (Region 2)

-Improving North mountains

-Improving East mountains

-Kan river-valley improvement plan (region 5)

-Pardisan Park improvement and renovation plan (region 2)

-Improvement of the tourism reception center West zone (region 5,2)

The detailed description of the above plans has been presented in the Comprehensive plan. These descriptions will be presented to the urban planning consultant companies to prepare the project in details and do the further actions.

Conceptual plans and projects:

- Building and improvement of Tehran green belt

- Building and improvement of the parks and green spaces

-Qantas restoration

-Urban management system improvement plan

-Increasing citizens participation in Tehran urban management

-Produce financial resource management system and urban cost-benefit structure

-Improving (revision) urban organizations and structure management

5.6.6 Conclusions

The Master plan has different parts concerning green lands, environment and preservation. Sustainability of the preserved zones and ecosystem diversity, garden preservation, development of the agriculture, mountain preservation through greenbelt and controlling land allocation near the mountains, natural water stream preservation in the city, creating attractive recreational spaces on the river banks, preserve and develop the gardens, natural parks, urban parks, development of the green recreational public spaces, green spaces development in urban, regional, district and local scale to provide at least 10 m^2 green space per capita in Tehran, protect and utilize the natural parks, preservation zone including open and green spaces with 107 km^2.

The above mentioned parts are a suitable means to emphasize the importance of green fields in Tehran and the necessity of having and preserving more green spaces but the content of the plan is not realistic enough to be implemented in a real life. The description of Tehran and the vision which has been set is similar to utopia and makes the official plan very hard to be implemented in the practice. The image which attends to be reached is so far from the reality of Tehran and therefore not feasible. It has been forgotten to solve the fundamental problems first and then draw Tehran as a green, healthy, shining and modern city. It has not been mentioned how these visions can be met in reality and the means to reach the goal have not been mentioned. It is clear that the character of the Comprehensive plan should not explain the details of implementation but the theory should be designed based on the means, sources and facilities available to make them real in practice. Any city can be as

beautiful and functional written in the Comprehensive plan but this plan has to characterize Tehran and consider which visions are realistic for Tehran with the certain qualifications.

Relating high rises, it is clearly written that “From this date on high rise construction or issuing any construction permission by municipality for high rises in all Tehran zones with any land use is not allowed”; however, in practice this statement has not been implemented in Tehran and still the high-rises are being constructed. Providing a plan itself will not help the city solve its problems; it needs a guaranty of implementation, not just a theory on paper.

Moreover, it is exactly written in the Master plan as a legal urban plan that Commission Code 100 has to change its point of view relating the city problems. It has been identified as an organization which does not fulfill its responsibilities thoroughly and intends to collect fines instead of providing the city with sufficient urban services. According to this statement which will be discussed in chapter 6, Commission Code 100 plays a crucial role concerning green lands’ destruction.

At the end it has to be mentioned that proposing ideal local/conceptual plans without taking into account the local economic, cultural and social feasibilities and circumstances will turn out to be vain attempt. Today, after more than 8 years since the Master Plan has been approved, very few of its proposed plans and ideas could be implemented. There is an enormous difference between developing a theory and its application. In order to have higher assurance regarding feasible plans, the planners have to think about the economic potentials and the possibilities in feasibility in the region. Otherwise, the plans will look nice and according to standards but there is not enough budget or ground to execute them.

5.7 Region 1 Detailed plan approach concerning green lands

The parts of Region 1 Detailed plan relating green lands and preservation will be reviewed here to present the approach of this plan to the research objectives. This Detailed plan is composed of nine chapters:

Chapter 1: Region 1 characteristics (status quo)
Chapter 2: Region 1 status in Tehran Comprehensive plan (2007)
Chapter 3: Development Pattern and spatial organization
Chapter 4: Road network
Chapter 5: Land zoning
Chapter 6: Zoning land uses
Chapter 7: Services
Chapter 8: Local Plan
Chapter 9: Urban distressed areas

5.7.1 Gardens background in region 1

From a long time ago gardens and valleys in Region 1 have been the reasons to turn this region into countryside of Tehran in hot summers. Till 1940s and 1950s this region and boundaries with the name of “Shemiran ”were apart from Tehran. Origin of the name comes from Tehran Safavid period. With urbanization and urban developments in 1950s and 1960s, this region was highly regarded by many royal families, authorities and elite due to its environmental unique characteristics. In addition, many of the foreign embassies have been centralized in this green region. ”Sadabad” and “Niavaran palace were both established in region 1 which shows the high standards of living in this region. In 1980s and 1990s in spite of vacant, unoccupied, undeveloped plots in the south and east of the region, more construction preferences belonged to the north of the region with 1600 to 1800 meters height. The region borders have been changed from 2005 and all 10 zones of region 4 has been attached to region 1. Physical characteristics of region 1 comparing to Tehran are presented in table 5.11.

Table 5.11: Region 1 physical indicators 2007

Physical Indicator	Region	Tehran	Explanation
Mean residential building density	181	164	Tehran indicator has been derived from Tehran Cadastre 2003-2004
Current residential units	127961	1850000	2006
Mean number of residential floors	2.9	2.24	2003-2004
Residential parcels mean area (m^2)	466	214	2003-2004
Mean building density (%)	150.95	119	2006
Mean number of floors	2.13	2.8	
Mean parcel area (m^2)	550	323	2003-2004

Source: Region 1 Detailed plan-Bafhshahr Consulting Company

5.7.2 SWOT analytical results

The SWOT analysis concerning green spaces, gardens and agricultural lands in region 1 Detailed plan will be discussed in this section. SWOT is the end part of the region status quo which refers to the conclusion of the Detailed plan. Table 5.12 has been derived from the content of the plan and presents the parts concerning green spaces (gardens, farmlands) in region 1 Detailed plan.

Table 5.12: SWOT analysis of Region 1 Detailed plan (status quo conclusions)

Strengths	**Weakness**	**Opportunities**	**Threats**	**Main region issues**
-The possibility of using the east brown fields ,vacant ,non built plots for green spaces development and required services	Huge military land use plots incompatible with adjacent land uses	Converting military land uses to required public service	-No municipality supervision over constructions inside military land uses and region borders	-Gardens and natural resources' destroying as a result of construction development
-Gardens and green land plots in high quantity in the region	Service deficiency intourism places	Investment tendencies in the region and redirecting the investment to tourism ,cultural and recreational sectors	-Urban gardens and rich fauna and flora of region in order to construct buildings	-Construction in riverbanks ,river borders and river boundaries
-Hills, valleys ,unique landscape and view ,visual corridors in the region	Low flexibility and resistance to earthquake	-stakeholders and authorities (political ,social and economical) in the region	-Regulations ,laws and restrictions deficiency and power of implementation	-Region location in Tehran northern faults and building structure incompatible with Tehran earthquake circumstances

Table 5.12: SWOT analysis of Region 1 Detailed plan (status quo conclusions)-Continued

Strengths	Weakness	Opportunities	Threats	Main region issues
-Garden–green organic alleys and open spaces as region identity	High building density	-High economic benefits of the region	-Land and house price increasing procedure	-Service deficiency in some parts of the region (new developments ,infill developments)
-Special environment region status as an advantage for high quality life	Open deficiency such as parks and green spaces for urgent helps in case of natural hazards or accidents in compact urban textures	-NGO support from the idea of mountain ,river and garden preservation	-Disturbing the existing socioeconomic balance by introducing cooperative complexes	-No exact borderline in North
-Higher level of education ,specialization of the region residents in comparison with the whole Tehran	Non listed natural ,historical and cultural symbols of the city	-Tourism-leisure role of a region according to Tehran Comprehensive plan	-High investment in housing and building in the recent years in the region	-Land and building high prices and its high growth rate
-Good status of density index (Residential density in a unit /householder per unit /occupancy rate (room density))	Visual corridors obstruction through high rises' wrong site selection	-Emphasize on natural ,green spaces in previous plans	-Land speculation because of selling density rights and property market return on investment and promoting middle man activities	-Investment in housing section for land speculation and housing manipulation and not responding the real demands
-The possibility of income generation municipality by selling density and renovation	-Expanding the construction in river banks		-Municipality budget dependant on selling density rights	
-Diverse ,natural ,historical and urban spaces for investment	-Municipality expenses increase up to 10 times in 1990s.		-constructions in the north of the region without legal permission by different government organizations	
			-Regulations and rules deficiency concerning building density	
			-The possibility of historical –cultural spaces' destroying as a result of no preservation	

Source: derived by author from Region 1 Detailed plan (2007)

5.7.3 Principle statement of region 1 development Pattern

"Stabilize and confirm the unique characteristics of the region as a tourism and leisure zone of Tehran with diplomatic (politic) and international activities development, preserving the functional and physical pattern of elite accommodations and redirecting economic investment to tourism section and providing service."

Development Pattern plans were prepared before Detailed plans. Their goal was to give a detailed view about different urban sections in that region such as: Transportation, population, land use, finance, housing, management, environment, natural hazards, physical organizations and city infrastructure.

Detailed plans have been based on the complete research done by Development Pattern plans. The main points mentioned in the region 1 Development Pattern plan concerning this thesis subjects are as followed: Redirecting economic investment flow towards service sector to preserve cultural, social and environmental identity of the region; Natural and environmental elements and characteristics preservation (such as river-valleys, gardens, Alborz Mountains)

5.7.4 Land use zoning

Figure 5.26 shows the current land use of region 1. Zoning principles by taking Development Pattern plan " and the plan vision into consideration for the whole region are as followed: Preservation of natural environmental characteristics (river-valleys, gardens); development of tourist reception and leisure functions; improvement of urban distressed area; improvement of valuable rural residential textures with preservation and historical-cultural identity revival approach; preservation of historical–cultural heritage; forecast for the possible service centers and zones with diverse functional approach.

Basic principles for zoning in this plan are as follows: strengthen the roles of river-valleys as they form the main structure of the region; specification of the riparian zones and preservation of the linear parks and open spaces in this area; preservation of the mountains, the northern limits of Tehran and controlling/redirecting physical changes in the north region in this plan by the specified areas recommended as greenbelt zones; taking the symbol elements of the region into consideration such as garden-embassies, the main service land uses with regional scale, religious centers and historical-cultural elements.

Region 1 zoning structure is based on the "Development Pattern". The zoning map with zones regulations, permitted land uses, building densities and building qualification and accessibilities is presented in figure 5.27 Tables 5.13 and 5.14 are related to this figure which indicates the recommended zoning by Detailed plan.

According to Tehran Comprehensive plan and providing Detailed plans, the main zones of Tehran are Residential (R), Work and activity (S), Mixed (residential and activity ,(M)), Green and open (preservation,(G)). Among all Tehran zones in Comprehensive plan, the below zones are located in region 1 (Table 5.13).

Islamic Republic of Iran

Housing and Urbanism Ministration-Tehran Municipality

Research and Urban Planning Center of Tehran
Joint Organization of Production of
Tehran Comprehensive and Detailed Plans

Region 1 Detailed Plan (2007)

Map Legend

- Net Residential
- Mixed Residential
- Commercial
- Green spaces and parks
- Open spaces and leisure
- Public services
- Industrial and workshop
- Transportation and parking
- Urban facilities and services
- Undeveloped lands
- Special land use-diplomatic
- Military
- Garden and Garden-residential
- Agriculture and ranching
- River
- Northern limits of the region
- Region limits

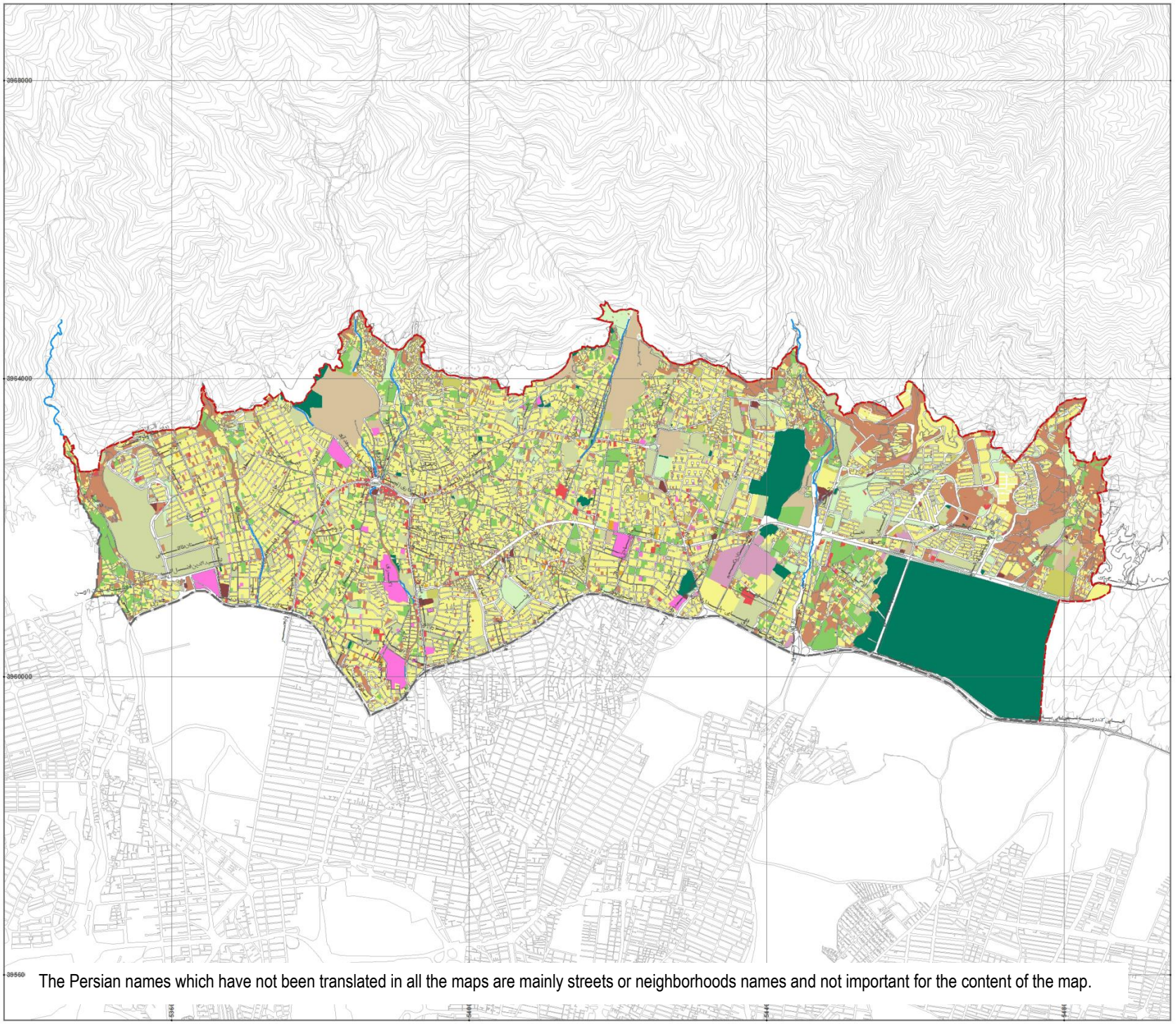
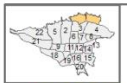


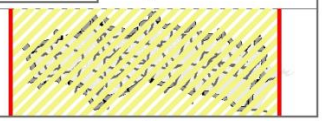
Figure 5.26: Current Land use Map

1: 50000 Map scale

0 700 1400 2100 متر

Key Plan





مدیر طرح:	بررسی و پژوهش:
کنترل:	GIS:
شماره طرح:	شماره پروژه:

Baftshahr Consulting Company (urban planners and architects)

The Persian names which have not been translated in all the maps are mainly streets or neighborhoods names and not important for the content of the map.

Islamic Republic of Iran

Housing and Urbanism Ministration-Tehran Municipality

Research and Urban Planning Center of Tehran

Joint Organization of Production of Tehran Comprehensive and Detailed Plans

Region 1 Detailed Plan (2007)

Map Legend

Residential Zone

- Residential with at least 250 m2 (in distressed areas with integrating) R111
- Residential with at least 200 m2 parcel size R112
- Residential with at least 480 m2parcel size R121
- Residential with at least 300 m2 parcel size R122
- Residential with at least 200 m2 parcel size R123
- Residential with at least 500 m2 parcel size R131
- Residential with at least 400 m2 parcel size R133
- One family Residential with at least 150 m2 parcel size R211
- One or more family residential R212
- Garden-Residential with at least 2000 m2 parcel size R241
- Small parcel size Garden-Residential R242
- Special residential of Central zone with the most density of 300% R251.1
- Special residential of Central zone with the most density of 240% R251.2
- Special residential of Central zone with the most density of 200% R251.3
- Special residential of Central zone with the most density of 180% R251.4
- Special residential with medium height of urban corridors zone R263

Mixed used Zone

- Outer regional mixed corridors (outer urban, urban, district) M111
- Regional mixed corridors M112
- Sub regional mixed corridors (district and local) M113
- Mixed residential with leisure and tourism dominance M211
- Special mixed use with tourism dominance M221

Activity Zone

- Traditional Bazaars (Markets) S111
- Work and Commercial and service activities with outer regional function S122
- Regional service areas and centers S213
- Sub-regional service areas and centers S214
- Areas of outer regional administrative and service activities S222
- Areas of regional administrative and service activities S223
- Areas of sub-regional administrative and service activities S224
- High technology industries S311

Green and Open Zone

- Urban parks G111
- Green spaces of village-rivers G122
- River boundaries G221
- Other boundaries G222
- Historical preservation zone (ancient and cultural) G231
- Other preservation zones G232
- Reserve plots for development and urban renovation
- Passive defense center
- Northern limits of the region
- Region 1 limits

Figure 5.27: Land use Zoning Map of region 1

1: 50000 — Map Scale — مقیاس

0 700 1400 2

Key Plan — راهنمای اتصال نقشه

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مدیر طرح: ا. سعیدنیا	بررسی و پیشنهاد: م. وطن دوست
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شماره طرح:	شماره پیوست:

Baftshahr Consulting Company
Architects and Urban Planners

The Persian names which have not been translated in all the maps are mainly streets or neighborhoods names and not important for the content of the map.

Table 5.13: Region 1 zones according to the Comprehensive plan

General Zones	Main Zones		Subzones (2 codes)		Subzones (3 codes)	
Residential (R)	**R1**	General Residential	**R11**	Low density residential	**R111**	Residential with at least 250 m^2 parcel size (in distressed area with condition of integrating)
					R112	Residential with at least 200 m^2parcel size
			R12	Medium density residential	**R121**	Residential with at least 480 m^2parcel size
					R122	Residential with at least 300 m^2parcel size
					R123	Residential with at least 200 m^2 parcel size
			R13	High density residential	**R131**	Residential with at least 500 m^2parcel size
					R133	Residential with at least 400 m^2 parcel size
	R2	Special residential	**R21**	Valuable rural residential texture	**R211**	One family residential with at least 150 m^2 parcel size
					R212	One or more family residential
			R24	Garden-residential	**R241**	Garden-residential with at least 2000 m^2 parcel size
					R242	Garden-residential with at least 1000 m^2 parcel size
			R25	Special residential of central zone	**R251-1**	Central zone residential with the highest density of 300% and the lowest parcel size of 700 m^2
					R251-2	Central zone residential with the highest density of 240% and the lowest parcel size of 600 m^2
					R251-3	Central zone residential with the highest density of 200% and the lowest parcel size of 500 m^2
					R251-4	Central zone residential with the highest density of 180% and the lowest parcel size of 500 m^2
			R26	Special residential of urban corridor zones	**R263**	Residential zone with medium height
Activity (S)		Commercial and service	**S11**	Bazaar corridor	**S111**	Traditional Bazaars
			S12	Work and service activity	**S122**	Activity corridor with outer regional function

	S1	activity	**S21**	Areas and centers of commercial and administrative (profitable)	**S213**	Regional service areas and centers
					S214	Sub regional areas and centers
	S2	Commercial and administrative (with green and open spaces dominance) areas and centers of service activity	**S22**	Areas of administrative activities (non-profitable with commercial and service land use	**S222**	Areas with ultra-regional administrative and service activities
					S223	Areas with regional administrative and service activities
					S224	Areas with sub regional administrative and service activities
	S3	Industrial-workshop	**S31**	Factory industries	**S311**	High technology industry
Mixed (M)	**M1**	Activity and residential	**M11**	Commercial, service and residential mixed	**M111**	Outer regional mixed use corridors
					M112	Regional mixed use corridors
					M113	Sub regional mixed use corridors
	M2	Tourism and residential	**M21**	Mixed mountains	**M211**	Mixed with tourist reception and leisure dominance
					M212	Mixed used with tourism dominance
Preservation(G)	**G1**	Public green spaces	**G11**	Urban parks	**G111**	Urban parks
				Natural parks	**G112**	River-valley green spaces
	G2	Private green spaces special riparian zones	**G22**	Boundaries	**G221**	Riparian zones
					G222	other boundaries
			G23	Special zones	**G231**	Historical preserved zone(ancient and cultural)
					G232	Other preserved zones

Source: Region 1 Detailed plan-Baftshahr consulting company (translated by the author)

Table 5.14: Zone's characteristics in the Detailed plan zoning map of region 1

General zones	Main zones			Subzones (2 codes)			Subzones (3 codes)		
	Area (hectares)		Percentage	Area (hectares)		percentage	Area (hectares)		Percentage
Residential (R)	**R1**	2178.41	47.63	**R11**	307.99	6.73	**R111**	46.81	1.02
							R112	261.18	5.71
				R12	1685.61	36.86	**R121**	80.17	1.57
							R122	917.71	20.07
							R123	687.73	15.04
				R13	184.81	4.04	**R131**	22.21	0.49
							R133	162.6	3.56
	R2	507.27	11.09	**R21**	4.45	0.91	**R211**	28.36	0.62
							R212	13.09	0.29
				R24	120.57	2.64	**R241**	83.42	1.82
							R242	37.16	0.81
				R25	317.82	6.95	**R251**	317.82	6.95
				R26	27.41	0.6	**R263**	27.41	0.6
Activity (S)	**S1**	9.75	0.21	**S11**	9.75	0.21	**S111**	6.27	0.14
				S12	3.48	0.08	**S122**	3.48	0.08
	S2	534.24	11.46	**S21**	61.06	1.33	**S213**	33.86	0.74
							S214	27.20	0.59
				S22	473.18	10.34	**S222**	370.41	8.1
							S223	84.56	1.85
							S224	18.21	0.4
				S31	37.41	0.82	**S311**	37.41	0.82
Mixed (M)	**M1**	256.22	5.6	**M11**	256.22	5.6	**M111**	182.68	3.49
							M112	36.68	0.8
	M2	83.13	1.82	**M21**	76.04	1.66	**M211**	76.04	1.66
				M22	7.08	0.15	**M221**	7.08	0.15
Preservation (G)	**G1**	249.59	5.41	**G11**	240.39	5.25	**G111**	240.39	5.25
				G12	7.20	0.16	**G122**	7.20	0.16
	G2	719.28	15.73	**G22**	156.26	3.42	**G221**	76.55	1.67
							G222	79.71	1.74
				G23	563.03	12.31	**G231**	22.05	0.48
							G232	540.98	11.82
Total	**3.32457**		**100%**	**4573.32**		**100%**	**4573.32**		**100%**

Source: Region 1 Detailed plan-Baftshahr consulting company (translated by the author)

According to the Comprehensive plan framework, in each of General zones (residential, activity, mixed and preservation) some areas have been considered as reserve lands for urban development and renovation. In region these lands comprise three groups; the first one contains relatively huge open spaces (in regards to urban grain and morphology of region 1) which have not been zoned according to the zone function. As an example of such an area is Masihdaneshvari hospital with 14.5 hectares. The second group includes lands allocated to green land uses, public parks and urban infrastructures in the Detailed plan and all the previous approved plans with more than half a hectare. In region 1 these lands comprise about 127.46 hectares and the last category have lands with incompatible land uses with urban ones such as Aghdasiye military barrack with 52.8 hectares and military lands in East of Ozgol.

These lands are resources for providing services and development investments in the city and will be used by sets of mixed use land uses (service, commercial, administrative, tourism) coordinated with urban demands and the required services according to plan regulations.

5.7.5 Building density of residential zones

Through preserving the natural structure of the region as one of the northern regions of Tehran, elevation of the tourism condition and control any damage to the northern mountains, reducing building density according to the Comprehensive plan will be taken into consideration as well. Gross building density in different residential zones close to mountains area is at most 300% for regular residential zones. In special Garden-residential zones and their boundaries, the building density has been proposed less than 120%. The average building density with taking the site occupancy index into consideration has been calculated to 138%.

The population policy in the Comprehensive plan for this region is to try to get region population to stabilize at 413 thousand citizens and prevent it from increasing. However, according to the consulting company population studies (Baftshahr Company), migration-receptive characteristic of the region and the elite increasing tendency to move to region 1, population stabilization is not a realistic idea.

In all urban residential patterns, in order to eliminate the need of population movements, selling, purchasing and construction a percentage of units often stay vacant. Due to the land investment as a residential settlements in region 1 (land speculation) and the investors interested in this region, this fact is estimated around 6% of the whole units in 2021.

Floor area (built-up area) changes are forecasted from 90 m^2 to 350 m^2 for each residential unit and the average with taking site occupancy index into consideration will be about 228 m^2 in the whole region. Residential Index in each zone has been used to calculate the essential space for the residential area and local/nonlocal services. In residential zones where the main function is accommodation and other activities have been limited to local daily needs, this index has been calculated between 65% and 80% according to the zone characteristics. In the mixed zones in which accommodation has less priority, residential index is calculated 30% to 40%. By taking all the above points into consideration, until 2021 the number of residential units in region 1 is predicted to grow to about 133468 units from which 8008 units are vacant.

The number of people in a residential unit until 2021 will be about 3.1 people/unit, so this number of units will be sufficient for 413000 citizens. The summary of residential buildings' characteristics in region 1 is as table 5.15.

Table 5.15: Residential buildings characteristics in region 1

Population	Number of residential	Number of people in a residential unit	Average density of residential building	The average built up area of residential unit
413750	133468	3.1	%138	228 m^2

Source: Region 1 Detailed plan-Baftshahr consulting company (translated by the author)

5.7.6 Comparison between zoning and existing land uses

In 4573 hectares of region 1, around 57% is allocated to residential land use. Table 5.16 indicates the procedure of converting the existing land uses and areas to recommended zones.

Table 5.16: Existing land use and proposed zoning comparison

Proposed zoning		Current land use	
General zones	**area in hectare[1]**	**Main land uses**	**area in hectare**
Residential	2681.21	Residential	1657.4
		Garden-Residential	275.57
		special land use (garden-embassy)	62.22
		roads/pavement(paths)	633.1
Activity	581.4	Services	803.58
		Commercial and administrative	105.94
Mixed corridors and	256.22	Industrial	40.35
Areas with commercial		Transportation and parking	15/59
And administrative activity dominance		Open and leisure spaces	163.43
		Paths	52.82
Preservation	971.07	Park and green spaces	173.96
		Agriculture and cattle breeding	0.78
Mixed of tourism reception	83.13	Undeveloped areas	447.93
and leisure		Paths	140.63

Source: Region 1 Detailed plan-Baftshahr consulting company (translated by the author)

Green spaces, urban parks, undeveloped lands[2] in the eastern part of the region, approved riparian zones of river-valleys and the northern mountains belong to preservation zone. Figure 5.26 in the right side column and figure 5.27 is the left side column of the table 5.16.

All the significant main land uses should be preserved as "unchangeable land use" in land use map, and are presented separately in figure 5.28 and are composed of:

- Main urban services such as universities, colleges, main hospitals, recreational places, cultural centers such as: Shahidbeheshti university, Darabad museum, Bahonar sport center and Niavaran cultural center.
- Garden-embassies governmental centers such as Russian garden-embassy ,Turkey garden-embassy ,Germany garden-embassy, Italy garden –embassy
- Green spaces and main parks such as Gheitariye parks, Niavaran park, Jamshidiye park
- Valuable gardens and palaces with historical background in the region which have been categorized as general land uses now.

5.7.7 Boundaries and construction limitations

The elements mentioned below show the construction limitations. That means the space in the city where no construction should be permitted. The most important boundaries in region 1 are as followed: Fault lines boundaries which consist of three main fault lines and couple of secondary; second boundary contains river boundaries which in region 1 are 7 river-valley and have all legally approved boundaries; the third one is High voltage direct current which is located in district 10 of the region and has the approved boundaries; the forth construction limitation includes historical monuments and places and the last one is the highway verge which according to the regulations most of them must be 100 meters but Imamali highway verge is in the Darband river bank and a highway with its verge is 55 meters width.

[1] By calculating the inner zone paths

[2] In Iranian regulations this kind of undeveloped lands are the ones which had a usage in the past but because of the negligence any certain reason have been deserted for duration of 5 consecutive years.

Figure 5.29 shows the construction limitations according to the above urban elements. In the certain specified distances from the mentioned elements (fault lines, highway, river, and high voltage direct line) any urban construction should be prevented.

5.7.8 Hierarchic structure of urban services in region 1

In this section of the Detailed plan urban services in region 1 have been divided in 2 main categories. The first one is green space and parks and the second category is public services (educational and university, cultural, health, sport, religious and recreational and tourism) and urban facilities and utilities. Table 5.15 shows these 2 recommended land uses per capita in the regional scale by the Comprehensive plan which must be followed in any Detailed plan.

Table 5.17: Recommended land use per capita in Tehran Comprehensive plan

Kind of service	Outer regional services(m^2/person)	Regional ,district ,local services (m^2/person)			
Educational ,health, cultural ,recreational, ,sport ,religious and urban facilities	6.8	2.5	1.6	1.4	5.5
Green spaces and parks	5	2	1.5	1	4.5

Source: Detailed plan 2007-Baftshahr consulting company (translated by the author)

With taking the above table into consideration and the recommended population of the region in 2021, the land use deficiencies have been calculated below in table 5.16. In order to provide the deficiencies mentioned in the previous section on 7 services[1] and to create a green space plan, the current (status quo) area of different services and green spaces and also the population statistics of local, district and regional scales in 2006 have been gathered. All of these information and the required land use areas are presented in as table 5.18.

Table 5.18: Estimation of the required urban service areas in region1 until 2021

Service type	Regional service area(hectare)			District service area (hectare)			Local service area (hectare)			Sum of service (hectare)		
Green land and park	Current	Required	Deficiency	Current	Required	Deficiency	Current	Required	Deficiency	Current	Required	Deficiency
	61.58	124.13	62.55	17.58	62.06	44.48	62.55	41.38	-	141.71	227.57	81.26
7 service land uses	259.89	103.44	-	95.55	66.2	-	50.69	57.69	7.24	406.11	227.57	-
Sum	**321.47**	**227.56**	**62.55**	**113.13**	**128.26**	**44.48**	**113.24**	**99.3**	**7.24**	**547.84**	**455.14**	**81.26**

Source: Detailed plan 2007-Baftshahr consulting company (translated by the author)

Figure 5.30 shows the hierarchic services and green spaces of region 1 recommended by the Detailed plan. Table 5.19 indicates each land use per capita in region 1 in 2 categories; status quo and estimated required land use.

[1] Educational ,health, cultural ,recreational, ,sport ,religious and urban facilities

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Region 1 Detailed Plan (2007)

Map Legend

- Unchangeable Land uses
- River
- Northern limit of the region
- Region 1 limits

Unchangeable Land uses:

The goal is to preserve the value of these land uses.

Figure 5.28: Region 1 Unchangeable Land uses Map

1: 50000 Map Scale

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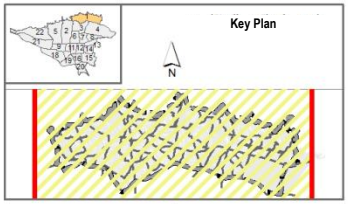
Key Plan



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Islamic Republic of Iran

Housing and Urbanism Ministration-Tehran Municipality

Research and Urban Planning Center of Tehran
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Region 1 Detailed Plan (2007)

Map Legend

- The Main Fault lines
- First level boundary of the main fault lines (200m)
- Second level boundary of the main fault lines (150m)
- Secondary fault lines
- First level boundary of the secondary fault lines (125m)
- Second level boundary of the secondary fault lines (100m)
- River boundary
- High voltage power line
- High voltage transmission line boundary (40 m)
- Highway boundary (55 m)
- Preserved boundary of historical monuments (120%density limitation)
- Northern limits of the region
- Region borders

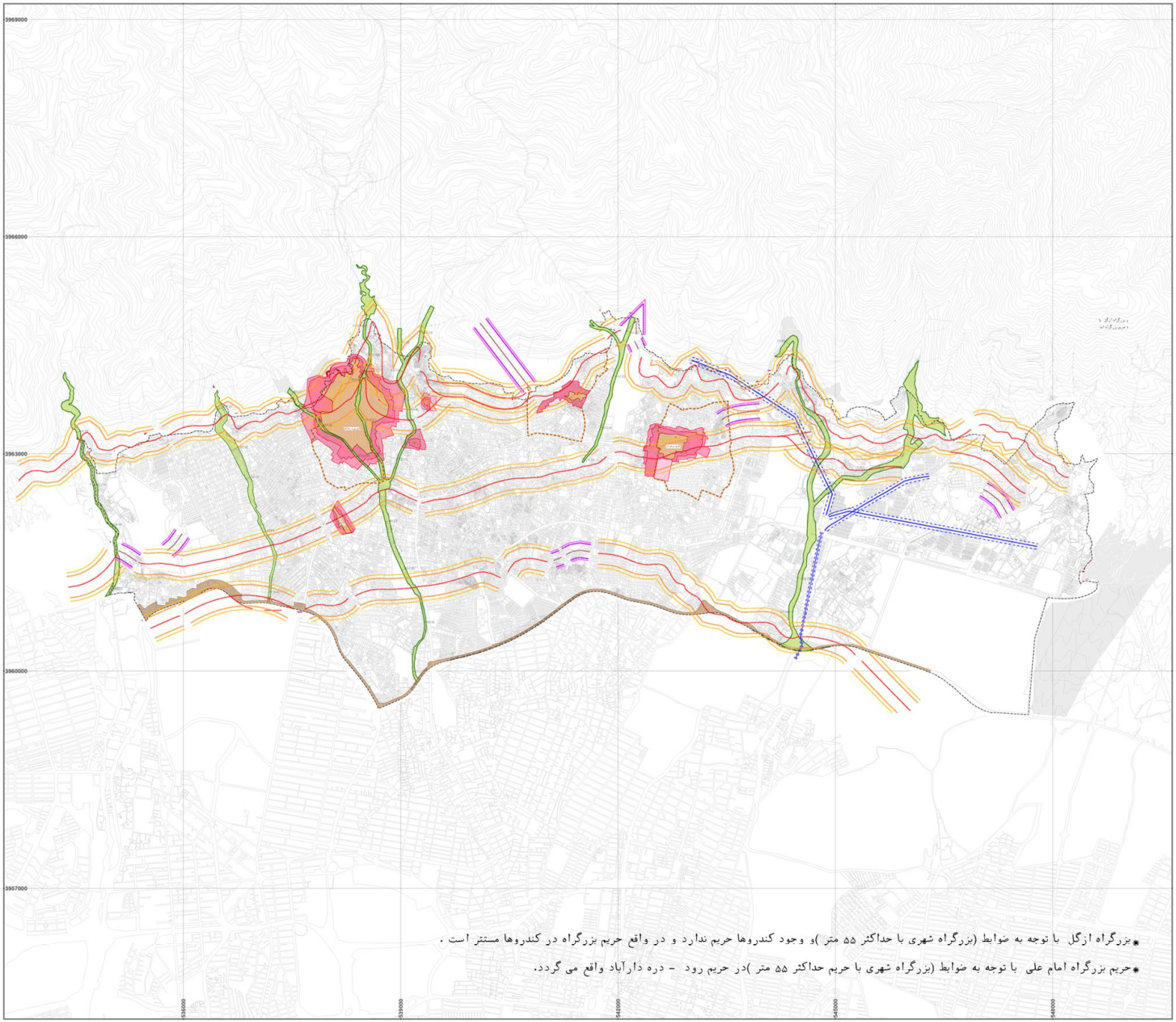

Figure 5.29: Boundary and construction limitations in region 1

Map scale

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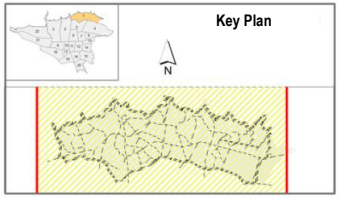
Key Plan



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شماره طرح:		شماره پـروژه:	

Baftshahr Consulting Company (urban planners and architects)

بافت شهر مهندسین مشاور

*بزرگراه ازگل با توجه به ضوابط (بزرگراه شهری با حداکثر ۵۵ متر)و وجود کندروها حریم ندارد و در واقع حریم بزرگراه در کندروها مستتر است .

*حریم بزرگراه امام علی با توجه به ضوابط (بزرگراه شهری با حریم حداکثر ۵۵ متر)در حریم رود - دره دارآباد واقع می گردد.

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Region 1 Detailed Plan (2007)

Map Legend

- Outer regional mixed used corridors
- Regional mixed used corridors
- Sub regional mixed used corridors
- Proposed outer regional services center
- Regional service center
- Sub regional service center
- Local service center
- Linear park on river bank (boundary)
- Urban park
- Regional park
- Sub regional park
- Green Boundary
- Northern limits of the region
- Region borders

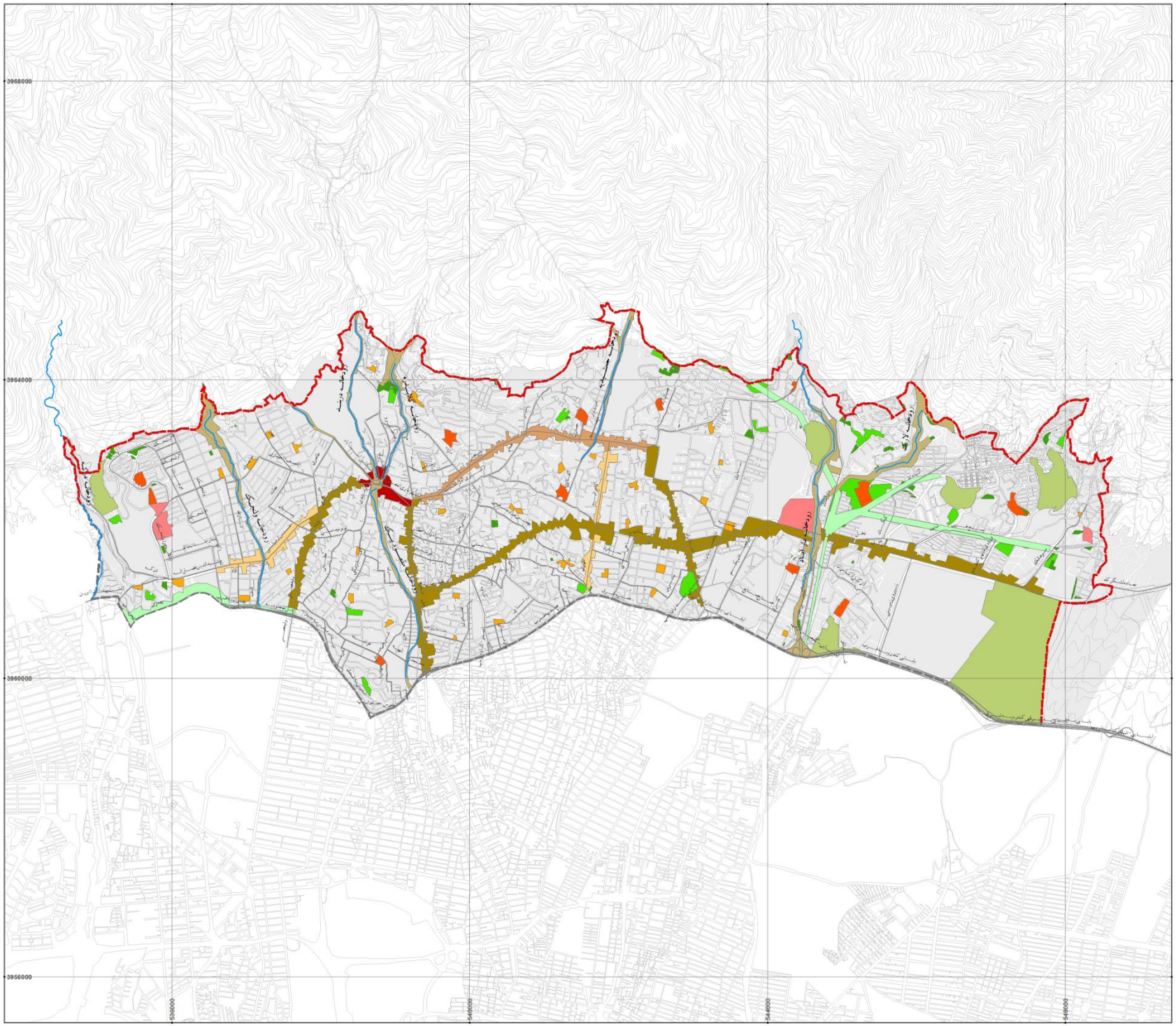

Figure 5.30: Hierarchic urban service and green spaces

1:50000 Map scale
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Key Plan

مدیر طرح: ا. ـــــ سیدنیا	بررسی و پـــژوهش: م. وطن دوست
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شماره طرح:	شماره پـــروژه:

Baftshahr Consulting Company (urban planners and architects)

Table 5.19: Current and required areas of urban services in region 1 (with 2012 estimated population)

Services		Status quo		Required		The total condition of the area (hectare)
		Per capita (m^2/person)	Area (hectare)	Per capita (m^2/person)	Area (hectare)	
Green space and park		4.2	173.96	9.5	393.06	**-219.1**
7 urban services	Education	1.95	81.73	2.9	119.98	**-38.25**
	Health	1.04	43.07	1.3	53.78	**-10.71**
	Cultural	2.29	94.65	1.4	57.92	**+36.73**
	Religious	0.22	9.24	1	41.37	**-32.13**
	Sport	1.25	55.82	1.9	78.61	**+22.79**
	Recreational and tourism	3	124.22	1.4	57.92	**+66.3**
	Urban facilities and utilities	1.14	47.3	2.4	99.3	**-52**
Sum of all		**15.19**	**629.9**	**21.8**	**901.94**	**-272.04**

Source: Detailed plan 2007-Baftshahr consulting company (translated by the author)

5.7.9 Local/conceptual plans

The Detailed plan has presented a long list of proposed *local plans* in different fields for region 1. In this section those concerning the subject of the research will be mentioned. In the Comprehensive plan, the following plans have been suggested for region 1:The improvement of northern mountains and river-valleys; the improvement of historical-cultural zones: Sadabad,Darabad ,Tajrish, the improvement of valuable rural zones: Evin, Darabad, Baghshater, Emamzade ghasem, Abak, Jamaran, Dezashib, chizar, Diavaran, Darabad, the improvement of military zones north of Babai highway.

Natural valuable zones which should be taken into urban authorities' consideration are as followed: Green belt preserving northern Tehran; mountain parks (river valleys among mountains); well-equipped linear parks (river – valleys and their banks inside urban textures); garden-residential zones in Ozgol and the symbolic hills and valuable open/green spaces in the region (Simin Ghaleh, Malek garden, Diba garden)

Region 1 Detailed plan proposed *conceptual plans* as followed: Acknowledgement of green open space network structure and environment sustainability of the whole region; discovering and mapping water basins and watersheds in the region; zoning the region according to natural hazards and earthquake; preservation, restoration and activation of valuable elements and buildings of region 1 and site selection (to locate the appropriate land) for foreign diplomats' accommodation in the region.

The *local plans* proposed by region1 Detailed plan are: creation of the preservation green belt in north of the region; urban-environmental design of river-valleys and their banks inside the city (linear parks along the rivers); urban –environmental design of valleys among mountains (mountain parks) to develop tourism and preserve high mountains and river-valleys; converting military land use of northern Babai highway to mixed use service and green space centers; converting Aghdasie land use to mixed use service, commercial and residential centers; urban-environmental design of simin Ghaleh hills as green space and District Park; urban-environmental design of Ozgol gardens and urban –environmental design of Darake gardens.

Commission Code 5 presents the following suggestions regarding region 1 on 30.05.2007: In addition to emphasizing on improvement plans of the river-valleys and preventing any construction on riparian zones, building any element on the river-valleys path must be according to environmental regulations. This is also towards the surveillance of water/soil resources contamination and to take the unique environmental characteristics of region 1 into consideration. Moreover, according to the land use zoning, any high construction inside region 1 municipality zones is not allowed. The final Detailed plan suggested map for region has been shown in (Figure 5.31).

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Region 1 Detailed Plan (2007)

Map Legend

- Low Density
- Medium Density
- High Density
- Very High Density
- Mixed Residential Density
- Educational
- Cultural religious
- Sport
- Health
- Transportation
- Parking
- Urban Services
- Urban facilities
- Public services
- Institutional- government
- Commercial
- Industrial
- Warehouse
- Green Space
- Agricultural
- Garden
- 25 years Tehran boundary
- High voltage power line boundary
- Pedestrian paths
- Impassable way

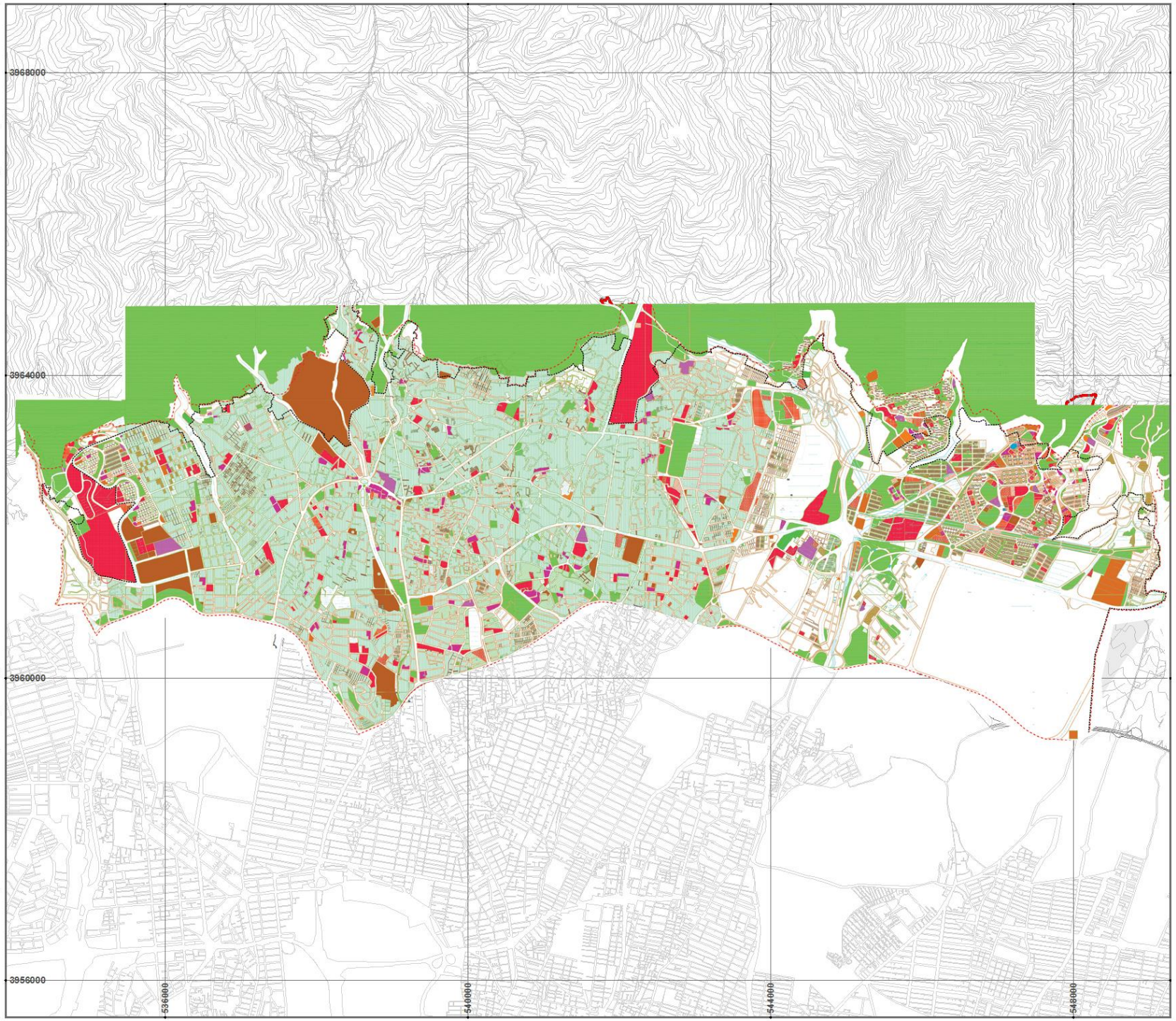

Figure 5.31: Detailed Plan

1: 70000 Map scale

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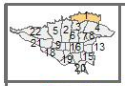
Key Plan



مدیر طرح: ا. سعیدیا	بررسی و پژوهش:
کنترل:	GIS:
شماره طرح:	شماره پروژه:

Baftshahr Consulting Company (urban planners and architects)

5.7.10 Conclusions and discussions

In spite of the fact that the main character of Region 1 is defined as a green region with valuable environmental assets for the whole of Tehran, there are not very outstanding policies or approaches in the region Detailed plan, when it comes to policy making and preserving these precious elements. This fact has been combined with the tourism character of the region and has been attempted to be solved by strengthening the tourism character as a means to bring more revenue and justify the green preservation economically. This approach may not be unacceptable. However, tourism itself can also lead to green destruction and there has to be a strict urban- legal approach solely allocated to green lands' conservation besides defining a function through which these lands can be preserved.
Region1 Detailed plan has described the status quo very well by emphasizing the environmental character of the region and its importance but it seems that this has not been considered as a main thread which the whole chapters of the plan has to stick to in order to get the pleasant scientific result and enhance the position and the function of the region.

The unchangeable land uses are defined in the plan and comprise just big parcels such as parks and embassies. However, no policies have been set for the smaller parcels which make a linear green network in the region. Hence, despite the importance of green field in this region which has been emphasized several times, the green network has been neglected and the approach to green lands is more restricted to either big parcels or separate important green elements. A comprehensive green network is missing in the plan. Moreover, it is not clear which exact definition has been selected for garden.

The Contraction emerges in the part of the Detailed plan on Commission Code 5. The suggestions made by this Commission in 2007 highlight the importance of environmental issues in this region and try to solve them. In respect to this matter and in order to follow the Comprehensive plan, high constructions have been announced as to be forbidden as well. Nevertheless, the approvals of the commission show a different point of view when it comes to decision-making. The reflections of these decisions are obvious in the image of region 1 even after 2007 which become compacter with new high-rises.

Commission Code 5 presented the following suggestions regarding region 1 on 30.05.2007: In addition to emphasizing the improvement plans of the river-valleys and preventing any construction on riparian zones, building any element on the river-valleys path must be according to environmental regulations. This applies also to the surveillance of water/soil resources contamination and to take the unique environmental characteristics of region 1 into consideration. Moreover, according to the land use zoning, any high construction inside region 1 municipality zones is not allowed.

5.8 Chapters regarding green spaces in "Development Pattern plan of region 1"

Since there is a part specified to constructions in gardens in "Development Pattern plan", here these parts will be reviewed by focusing on the parts concerning the research subject.

5.8.1 Garden –residential zone

In this plan which is provided as a fundamental plan for the Detailed plan, small residential zone has been recommended under the title of the residential zone. Garden-residential zones are also the sub zones of small residential zone. Two factors have been mentioned to specify a zone as a garden residential zone: Urban morphology (large urban grains with a plot area of more than 500 m^2) and a concentration of the residential units. According to these two factors garden-residential zones have been specified in figure 5.32. Figure 5.33 shows all subzones of small-residential zone: Garden-residential, cooperative housing (employer provided subsidized housing) and high rise (more than 240% building density). Table 5.20 shows the construction regulations which have been approved for garden-residential zone. The location of the codes in the table refers to the codes mentioned in figure 5.32.

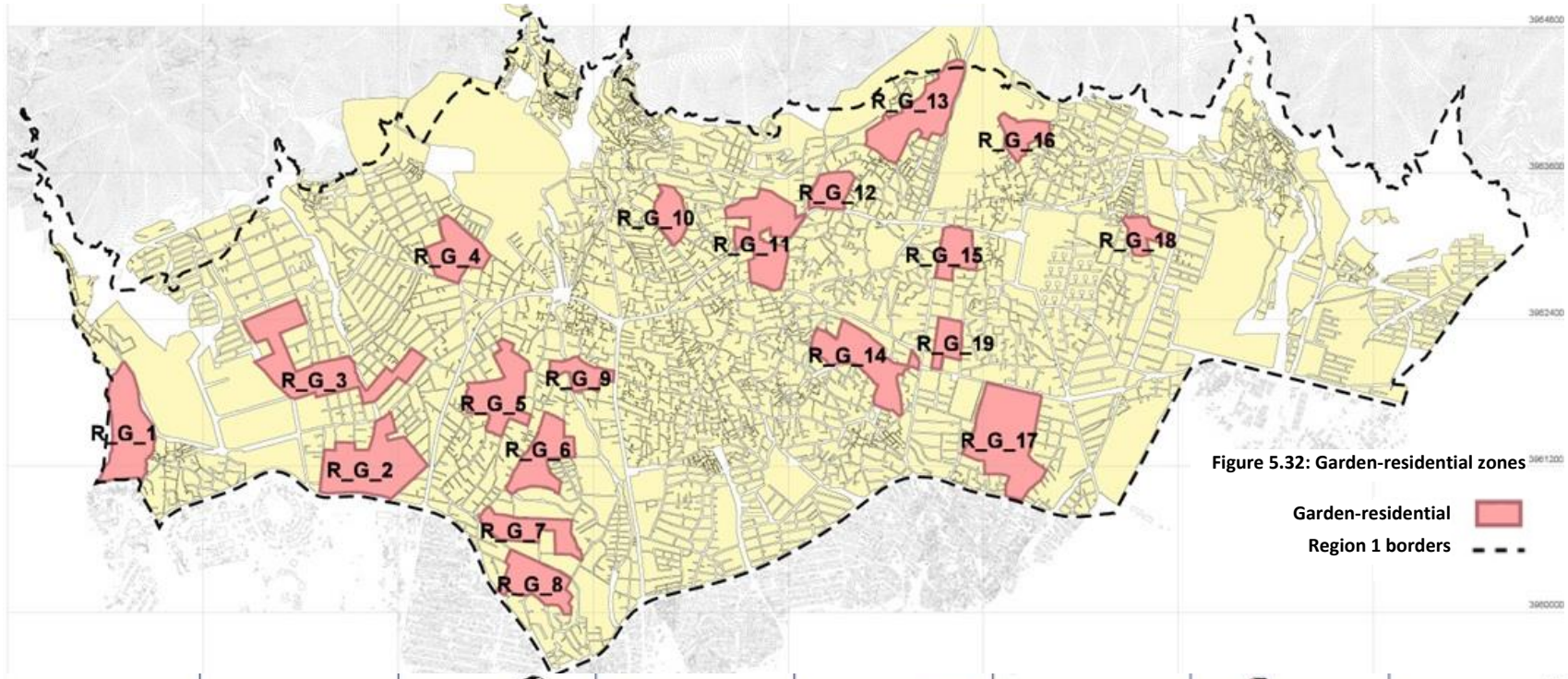


Figure 5.32: Garden-residential zones

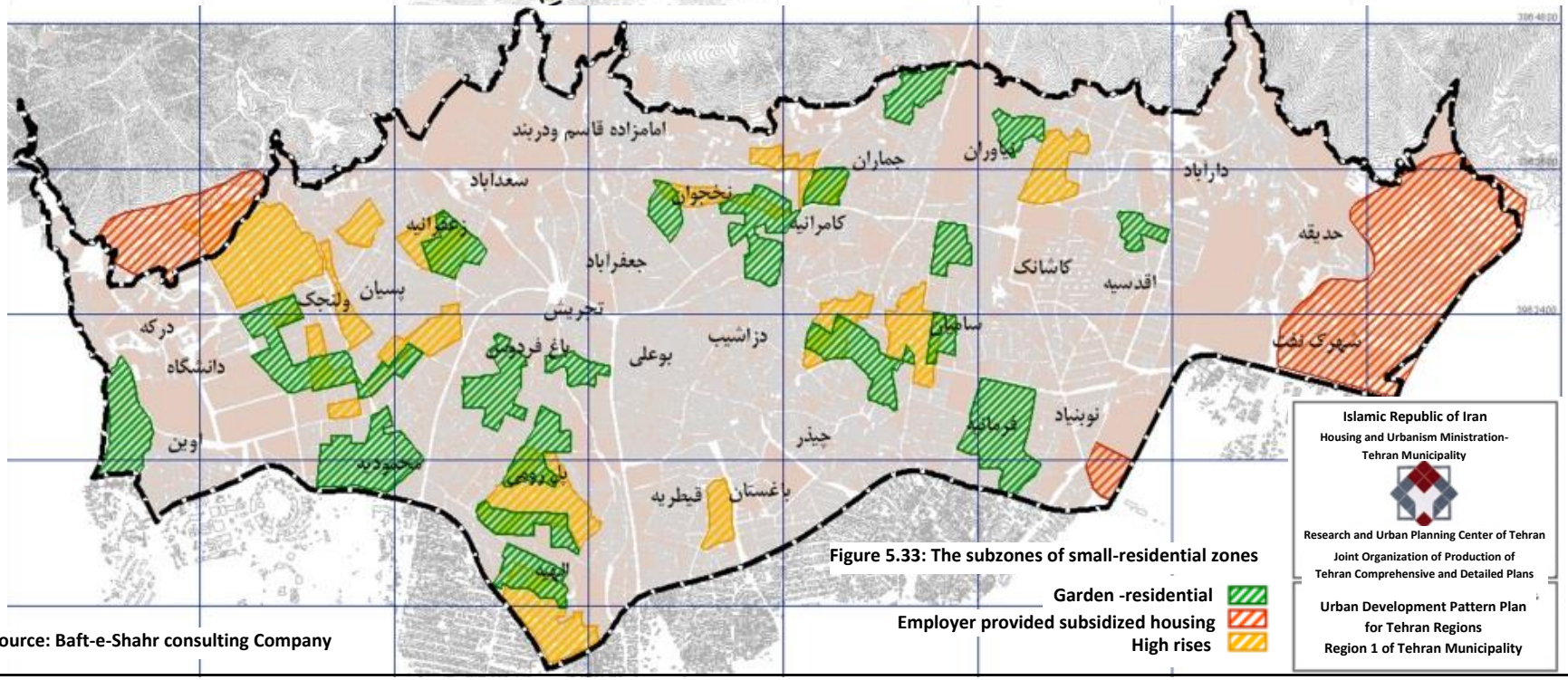


Figure 5.33: The subzones of small-residential zones

Source: Baft-e-Shahr consulting Company

Table 5.20: Construction regulations in garden –residential subzone

Sub Zone	FAR (floor area ratio)	Division area		Density		Land use		Explanation
		Current	Proposed	Current	Proposed	Current	Permitted	
R-G-1 Darakeh	30%	300-1000 m^2	More than 1000 m^2	120%	150 %- 210 % -	-Education -religious -transportation -tourism -sport -green -commercial	-green space -religious -commercial -sport -education -urban facilities and utilities	-Constructions in gardens must be in the parts of the plot with the least tree destroying. -preventing Any plot division for current garden-residential parcels in the region -Preservation of private green spaces and creating green corridors and public ,private green networks
R-G-2 Mahmoudieh		300-2000 m^2		120%-180%		-Education -facilities -green -sport -health -tourism -commercial		
R-G-3 Velenjak		300 -2000 m^2		120 %- 150 %		-educational -commercial -university -institutional -green -facilities -transportation -warehouses		
R-G-4 Zaferanieh		1000-2000 m^2		150%-240%		-facilities -institutional -recreational -sport -political		
R-G-5 Baghferdos		300-1000 m^2		120% -150 %		-educational -commercial -cultural -facilities		
R-G-6 (Pole roomi)		300-2000 m^2		120%-150 %		-educational -facilities -green -institutional -cultural		
R-G-7 (Pole roomi and Elahiye)		1000-2000 m^2		150% -240 %		-Educational -commercial -political -green -tourism -sport -facilities		

R-G-19 (Saman)	**R-G-18 (Kashanak)**	**R-G-17 (Farmaniye)**	**R-G-16 (Niavaran)**	**R-G-15 (Samian)**	**R-G-14 (Niavaran)**	**R-G-13 (Jamaran)**	**R-G-12 (Jamaran)**	**R-G-11 (Nakhjavan,Kamrani veh)**	**R-G-9 (Tajrish)**	**R-G-8 (Elahiye)**				
	30%													
1000-2000 m^2	500-2000 m^2	500-2000 m^2	300-1000 m^2	1000-3000 m^2	300-1000 m2	300-2000 m^2	300-1000 m^2	300-2000 m^2	300-1000 m^2	1000-2000 m^2				
	More than 1000 m^2													
120 %-240%	120%-180%	120%-180%	120%	120%	150%-180%	120%	120%-150%	120%-150%	120%-180%	120 %-180%				
	150 %- 210 %													
-facilities -institutional -educational	-facilities -religious	-educational –university -institutional -political -health	-facilities -green	-educational -institutional	Educational	-facilities -tourism	cultural	-Educational -institutional -health -facilities	-facilities -green	-educational -commercial -green -industrial -tourism -recreational -facilities	-political -religious	-green -facilities	-facilities -tourism	-commercial -green -religious

Source: Region 1 Development Pattern plan-Baftshahr Consulting Company -2005

5.8.2 Garden zones

Table 5.21 shows the construction regulations which must be followed in garden parcels. Permitted numbers of floors will change, if the garden parcel is located in zones without high rise permission.

Table 5.21: Construction regulations for gardens

Area	Street width	Construction built	Current and proposed regulations	Explanations
More than 300 m^2	12 meters and more	Before 1991	Number of floors:9 Permitted density :120% Occupancy rate:30%	Parcels with characteristics in this row, and without building must follow these regulations: Number of floors:8 Permitted density:120 % Occupancy rate :30%
Less than 300 m^2	Less than 12 meters	Before 1991	Number of floors:7 Permitted density :120% Occupancy rate:30%	Parcels with characteristics in this row, and without building must follow these regulations: Number of floors:6 Permitted density:120 % Occupancy rate :30%

Source Region 1 Development Pattern plan-Baftshahr Consulting Company -2005

Gardens along the main streets (Valieasr and Shariati) are allowed to have these land uses which are compatible with their functions: Converting gardens into public green spaces; converting gardens into recreational, tourism and cultural services; converting gardens into residential land use with a 30 % occupancy rate.
The disperse gardens in the urban texture of the region can comprise the following land uses:

Service land use with benefit for general public such as retirement home, orphanage will be by private or governmental section; Institutional-cultural land use such as cultural house, gyms, institutions include land uses with a limited number of visitors which are compatible with residential land uses. As a result these gardens must be purchased by municipality or other governmental organizations and are utilized by the public or the private sector.

Figure 5.34 shows the suggested land uses of region 1 and figure 5.35 indicates the preservation zones in the Development Pattern plan.

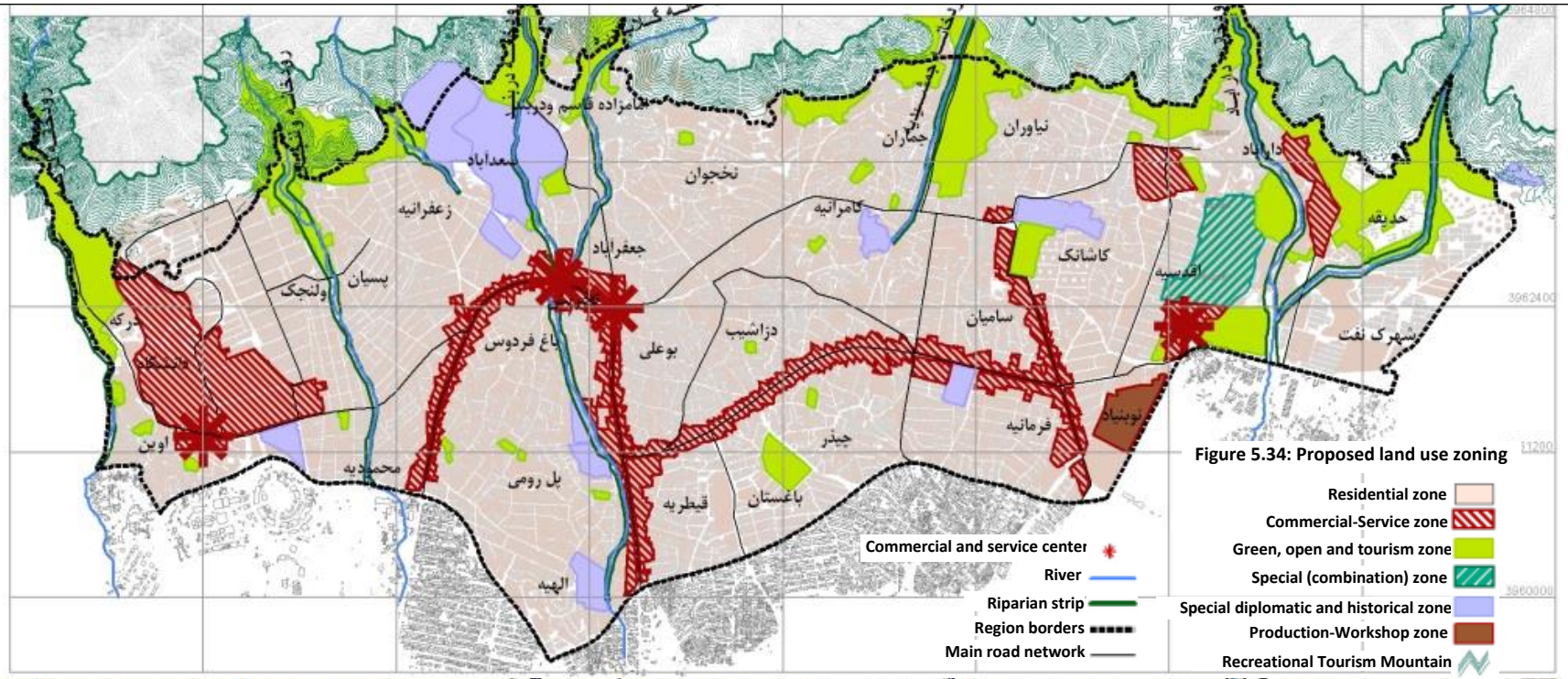


Figure 5.34: Proposed land use zoning

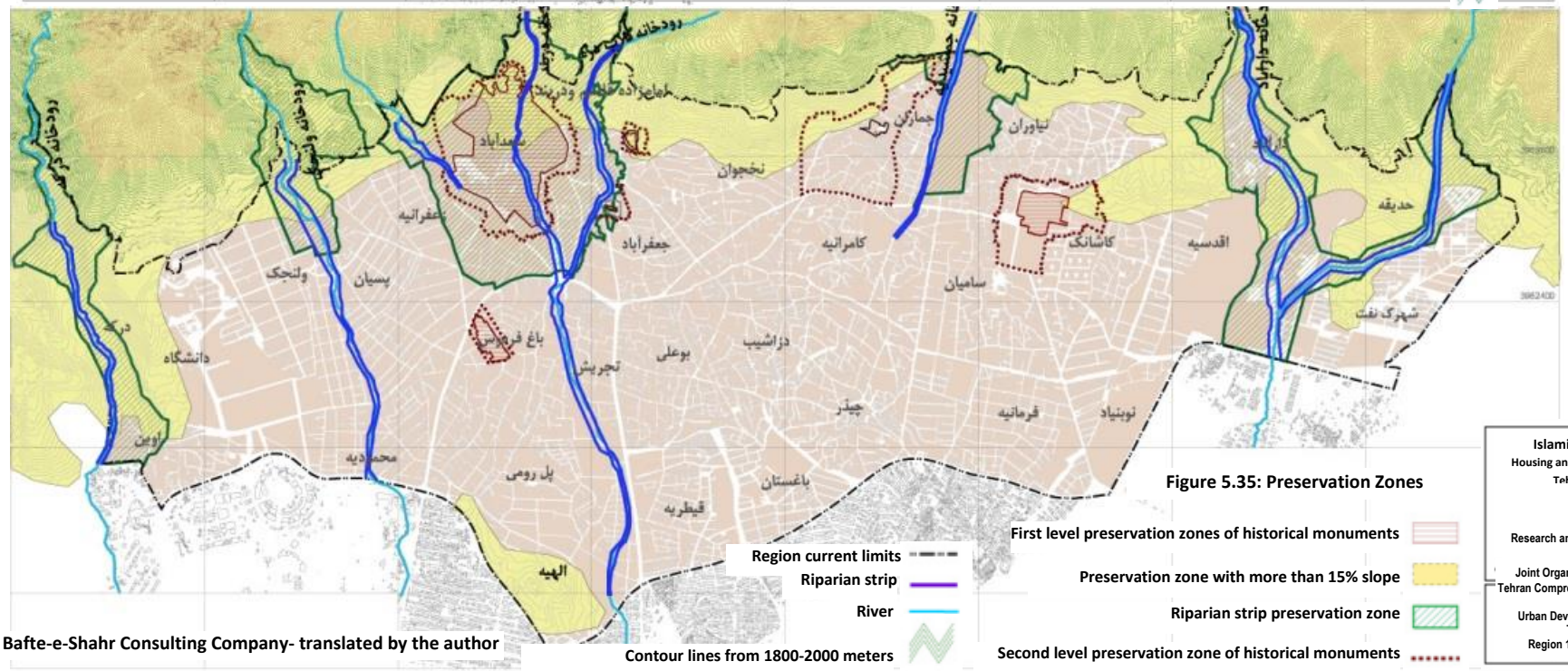


Figure 5.35: Preservation Zones

Source: Bafte-e-Shahr Consulting Company- translated by the author

5.8.3 Conclusions

This part has been concentrated on construction regulations in gardens which show the importance of this issue in region 1. However, the result of these regulations caused more green destruction. Since up to 9 floors have been allowed in the gardens, in spite of 30% occupancy rate, the high building needed parking lots and cellars. 30% of the land required digging very deeply in the ground to fulfill these needed spaces which was dangerous, difficult and costly. Therefore, the developers decided to use more percentage of the ground for parking, and in order to occupy 60% to 70% with fewer floors underground, the trees have to be chopped off. Moreover, allowing different land uses in the gardens is an incentive policy for keeping the gardens all around the world but the lack of exact regulations and circumstances for each made it easy to convert garden land cover to totally another with very few remaining trees.

The criteria for garden- residential zones are based on the legal definition of gardens in Iran law which is only for garden. Moreover, the 500 m^2 area criteria, the minimum area that Iran law considers as a garden, neglects many green parcels in the region which exhibit valuable old trees and can be connected to form a green network.

Another problem is the definition of high-rise in Iran urbanism which comprises 12 floors or more. That is the reason that the recommended regulations in the Development Pattern Plan seem convincing as they claim they do not suggest high construction in the gardens. However, in as densely built up as it is in Tehran and in an old region with narrow organic alleys which requires more space and air, 12 floors seem very giant for the residents living around the building. Even though the street width has been taken into consideration; 12 meters is not a sufficient distance for 9 floors building in such neighborhoods. It overshadows not just the street it is located in but also the whole block. In addition, even in small streets less than 12 meters width permission is given to buildings up to 7 floors which make an enormous cubic apartment in a narrow accessibility network. This fact becomes even more delicate if an extra building density is negotiable and free for purchase from the municipality.

Thus, the recommended regulations for construction in garden-residential parcels are not preserving the gardens but are to encourage the destruction of the gardens, and in many cases the proposed density is even higher than the current one.

5.9 Region 2 Detailed plan approach concerning urban gardens and agricultural lands

Since region 2 is the second region selected for the study, in this part the main plan for this region will be reviewed.

5.9.1 Spatial, physical, historical and socio-economic characteristics

Region 2, one of the north-west regions of Tehran comprises 4763 hectares and a population of 606734 people.

Table 5.22: population change process and area in region 2

Year / General characteristics	1986	1996	2002	2006
Population	269500	458100	559000	606734
Area(hectare)	No access	4957	4957	4763
Population density	No access	92	113	127

Source: Region 2 Detailed plan, Saravand consulting company, 2007

The physical development process of region 2 can be divided in 4 different historical phases: the first phase contains the formation of the first accommodation cores in rural area of the region; the second one is the beginning of a compact texture development in the southern parts of the region (near Azadi Street); in the third

phase the compact development spreads to the northern parts and in the fourth phase the development extends over the mountain parts, but decreases in the rural areas and converts these areas into problematic distressed rural-urban textures.

The socioeconomic indexes of region 2 such as family size, family income, and the number of families in residential units are shown and compared against the whole of Tehran data in table 5.23. The table shows the relatively good status of the region. Although the net population density has increased from 1996 to 2006, it is still much lower than the average of Tehran. This shows the number of people in the residential buildings. In contrary, gross population density is more than the whole of Tehran. This presents a region which has more number of people in its whole residential or non-residential surface. Family size has decreased from 1991 to 2006, from 3.8 to 3.31. According to 2006 statistics, the families are smaller than the average family size of the city with 3.36; this can be an indicator for the social level as well.

Table 5.23: Socioeconomic and physical characteristics of region 2

Socioeconomic and physical Indexes	**Region 2**			**City of Tehran**	
	1996	**2003**	**2006**	**City**	**Resource[1]**
Population	458089[2]	445505	606734	7738000	2006 statistics of housing and population
Occupation	126854	123338	-	1926000	2002 workshop statistics
Family size	3.8	3.81	3.31	3.36	2006 housing and population statistics
Number of existing residential units	118022	114834	182857	1487688	
Average of residential building density	143%	160%	156%	164%	Real property Cadastre of 2003-2004
Average of the numbers of residential floors	2.86	3.06	-	2.24	Real property Cadastre of 2003-2004
Average of residential parcel size (m^2)	336	321	-	214	Real property Cadastre of 2003-2004
Number of families in a residential unit	1.02	1.02	-	-	
Gross population density	96	90	127	125	
Net population density	276	310	378	442	
Average of family income	2876420	-	-	-	
Average of building density	-	139%	160%	119%	Real property Cadastre of 2002
Average of number of floors	-	2.7	-	2.13	Real property Cadastre of 2003-2004
Average of parcel size	582	450	-	323	
The ratio of resident people to employed people	10.11	10.66	-	4	

Source: Region 2 Detailed plan, Saravand consulting company, 2007

Regarding physical characteristics, the number of residential units has increased considerably from 2003 to 2006. This can be explained by the demands for space after immigration currents to this region and can be observed in the increasing residential building density too. The residential buildings have become higher and with average number of residential floors of 3.06 in 2003 are higher than the average of Tehran with 2.24 floors.

[1] This is the resource only for Tehran data.

[2] Data in the region has been derived from the different resources to match the date mentioned in the table:1996 census of Iran Statistic Organization, the consulting company analysis on 1996 and 2006 census, Management and Planning of Urban Development Plans Organization and Housing studies of region 2 in Saravand Consulting Company.

However, for non-residential buildings, this number is 2.7 in 2003 which is less than the residential one. This shows that the residential buildings are relatively higher than others but again in general all other buildings are higher than the average of Tehran as well. The average building density is 160%, whereas 119% in Tehran which shows the speed of constructions in the recent years after region 1 in this region. In general, region 2 is known as a region with bigger parcel divisions than many other regions and the average parcel size of 450 m^2 proves this assumption. This number for residential parcel is 321 m^2 which with taking into consideration the small family size and low net population density, the life comfort can better be understood in this region. This fact can be better observed in the north half the region from Pardisan Park (Figure 5.12).

The socioeconomic and physical indicators show that next to region 1 region 2 is a relative rich region compared to the others. Beside the smaller family size compared to the entire Tehran, the physical image comprises the higher building densities, higher of number of floors, bigger residential parcel size and higher gross population density when compared to whole of Tehran. It is spacious with a combination of villa district, residential complexes, high-rises and extensive open spaces around them. This kind of design makes the population density lower than the average of Tehran as well.

5.9.2 SWOT analysis concerning green spaces

In this part Strengthens, Weaknesses, Opportunities and Threats in the Detailed plan concerning the topic of the research will be presented (Table 5.24). As a conclusion of SWOT analysis the crucial issues of the region are natural hazards, environmental issues and the lack of balance between social and environmental indexes.

5.9.3 Region 2 vision in the Detailed plan

The optimum vision of the region has been selected among 2 alternative visions. This vision is coordinated with the Tehran vision in 2007 Comprehensive plan. The three main strategic subjects of the vision are summarized as: Enhance the role of the region as one with higher level services; tourism development role in the city scale and sustainable accommodation.

5.9.4 Spatial organization

Figure 5.36 shows the present spatial organization of region 2 in the Detailed plan and figure 5.37 presents the suggested spatial organization of the Detailed plan. This map has been selected out of different alternatives with different approaches. The main points that have been implemented in the selected spatial organization are: Path network and connectivity; functional corridors of the city between and inside region; urban centers both between and inside the regions.

5.9.5 Green space status quo of region 2

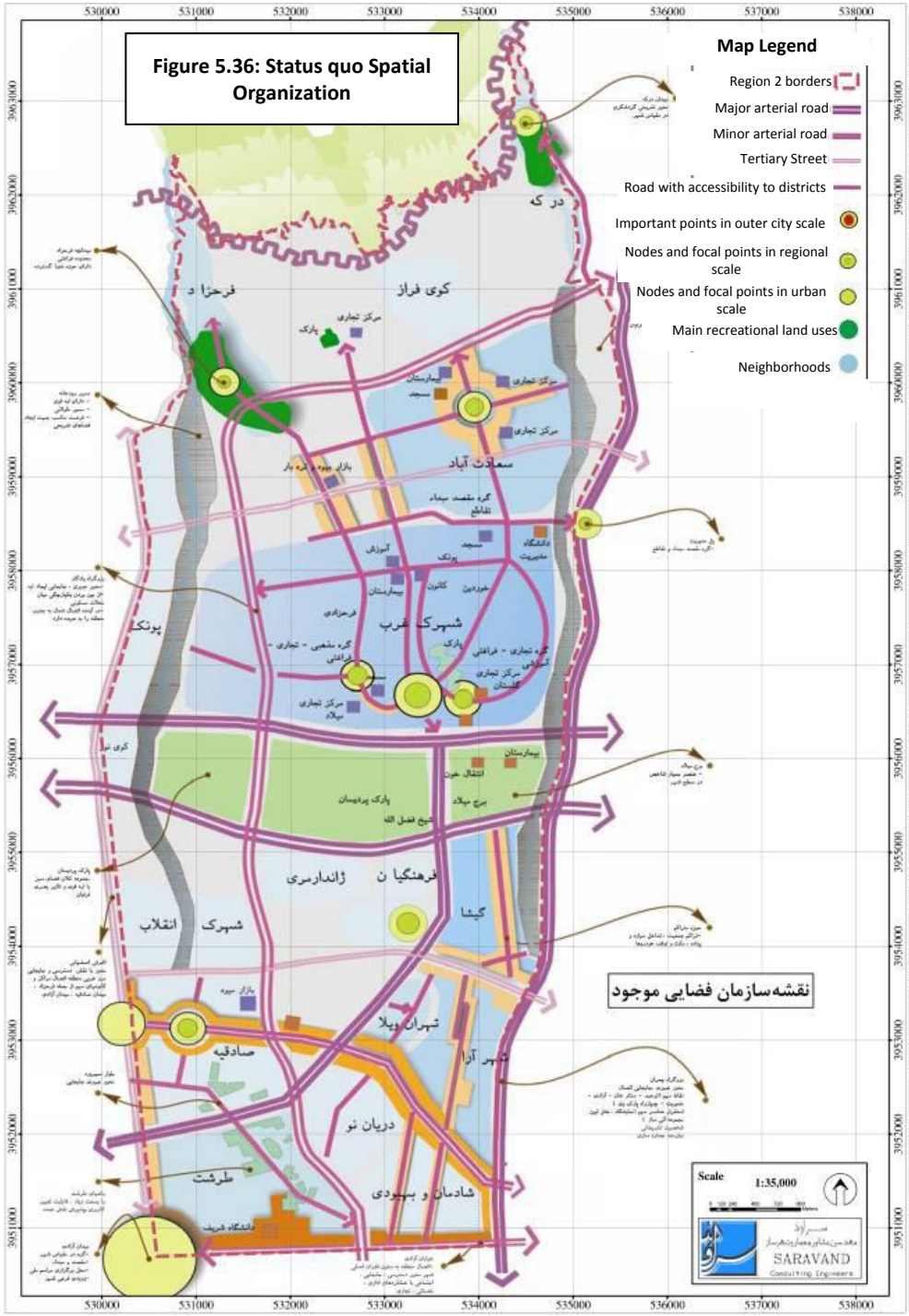
Some of green spaces characteristics of the region are as follows:

- Green space area: 5,956,476 m^2 (11,306,476 $m^2$with private green spaces and gardens)
- Green space per capita: 20,52 m^2
- Number of parks in the region: 102
- Number of gardens in the region: 418 parcel (199 parcels with less than 2000 m^2area and 226 parcels more than 2000 m^2)

Table 5.24: SWOT analysis of region 2 Detailed plan (status quo conclusion)

Strengths	Weakness	Opportunities	Threats
The better pollution condition of the region in comparison with other regions of Tehran and the existence of special microclimates.	Unsustainable financial resources for development	Tourism development in river-valley zones, foothills and Farahzad, Tarasht, Poonak	The possibility of new constructions and infrastructure destruction and people death because of the region fault lines
The high value of natural environment and living environment	Presence of incompatible urban land uses such as Evin prison, driving city	Presence of eastern and western valleys for high quality green space development and reinforcing air filter corridors	Population increase more than the facilities and the infrastructure capacity of the region
The high level of education, culture, incomes and university educated people	The high difference between housing indexes in northern and southern parts such as :average unit area from 221 m^2 in neighborhood 1 to 133 m^2 in neighborhood 13 (88 m^2 difference) , average of residential land per capita from 41.2 m^2 in neighborhood 2 to 21.4 m^2in neighborhood 7 ,average floor area per capita from 55.7 m^2in neighborhood 1 to 32 m^2in neighborhood 14	Investment and construction preferences in the region (by people and private sectors)	Presence of commercial ,workshop activities on residential and recreational activities
Open spaces presence with high quality such as Pardisan park, river-valleys and foothills	The high difference between education level in north and south parts of the region	The possibility of using Qantas water in urban consumptions and non-drinking water especially green space irrigation	Urban sprawl beyond the legal border of the city in northern part (1800 m height)
Farahzad and Darakeh rivers (streams) which irrigate the gardens and have crucial roles as two of Tehran's groundwater resources	Urban construction in riparian zones		Destroying the environment through not paying attention to river-valleys and foothills development quality
Relatively high level of the housing indexes' averages especially in the northern part of the region such as the number of families in a unit (1.02), the number of people in a room (0.9), the average number of sustainable buildings (97%)	The necessity of investment in green space maintenance ,management and development		
Existence of suitable riparian zones for most of the rivers	Lack of authority in the region such as municipality and financial organizations and policy makings		

Source: Region 2 Detailed plan, Saravand consulting company, 2007



Source: Saravand Consulting Company translated by the author

5.9.6 Urban green space changes (Open spaces, natural green spaces, artificial green spaces) using aerial photos analysis of 1989 and 2002

According to visual analysis done by using ArcGIS tools on the aerial photos received from National Geographical Organization with the scale of 1:40000, all green spaces were divided into 3 main categories: Open spaces are spaces without any construction, flora and land use; natural green spaces contain gardens and dense green spaces in river-valleys; artificial green spaces include parks and urban forests and manmade green spaces. The results of aerial photos analysis according to the categories explained above are presented in table 5.25.

Table 5.25: Results of aerial photos analysis between 1989 and 2002 in region 2

District	Relative density of open space in district (%)			Relative density of natural green space (%)			Relative density of artificial green spaces (%)			Relative density of all open and green spaces (%)		
	1989	2002	Percentage change	1989	2002	Percentage change	1989	2002	Percentage change	1989	2002	Percentage change
1	34.56	12.77	-21.78	8.73	5.8	-2.93	4.4	5.14	0.74	47.69	23.72	-23.97
2	28.87	14.57	-15.29	10.10	6.41	-3.69	0	8.86	8.86	39.96	29.84	-10.12
3	40.42	8.85	-31.57	0	4.3	-4.3	0.01	12.97	12.97	40.43	26.12	-14.3
4	42.51	7.45	-35.06	2.34	3.59	1.25	1.56	27.61	26.05	46.41	38.65	-7.76
5	7.77	4.62	-3.15	9.54	9.56	0.03	1.59	1.29	-0.31	18.91	15.47	-3.43
6	2.4	2.38	-0.02	3.2	2.48	-0.72	0	0.54	0.54	5.6	5.41	-0.2
7	18.00	8.21	-9.79	3.43	6.22	2.79	0.45	2.91	2.46	21.88	17.43	-4.55
8	2.71	14.84	12.13	44.56	6.86	-37.7	2.05	3.25	1.21	49.32	24.95	-24.36
9	61.86	31.84	-30.02	0	9.37	9.37	0	6.16	6.16	61.86	47.38	-14.49
Region 2	**28.20**	**11.3**	**-16.91**	**8.17**	**5.9**	**-2.27**	**1.42**	**8.68**	**7.26**	**37.39**	**25.87**	**-11.92**

Source: Region 2 Detailed plan, Saravand consulting company, 2007

The fist category comprises open spaces. According to the table, district 4 in region 2 has experienced the highest percentage change of open space density in urban districts between 1989 and 2002. This change is the result of plantation in Pardisan Park and surroundings. It is important to mention that this change is an open to manmade spaces conversion and is evaluated as a positive change.

The decrease of open green space density in district 8 is about 12.1 percent ensuing from destroying the gardens and converting them into building or open space (in construction waiting list). Therefore, this process is considered as a negative one in which green spaces lost their function (with land use conversion) to elevate the quality of urban environment. District 9 shows the most changes in open space after district 4. This change is due to the urban sprawl in the northern parts of Tehran such as region 2 with better status compared to the center and southern regions. By constructing “Yadegar Imam Highway” the dense integrated open space of Pardisan Park and its surrounding has been divided into two main parts and this action increased the construction on the highway verge.

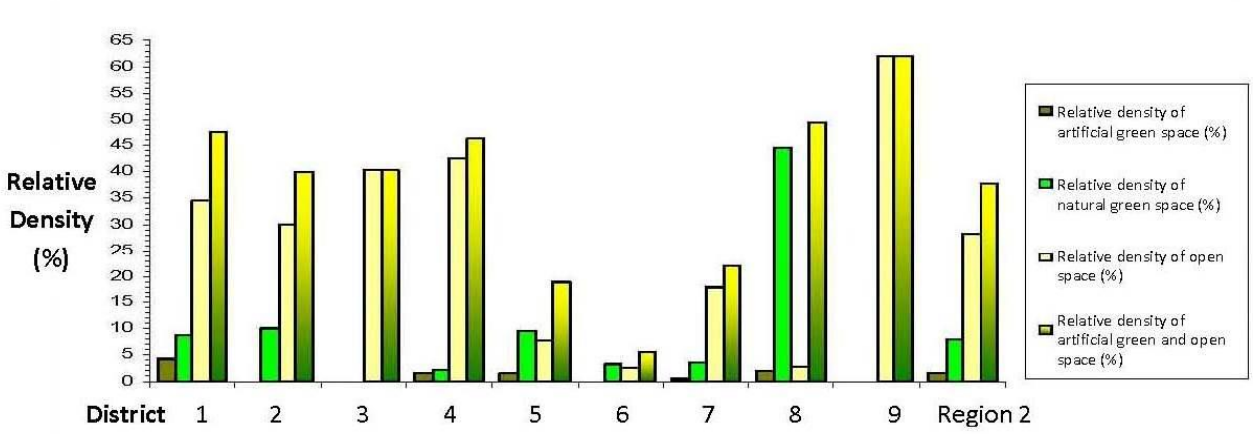
Open space density in northern districts such as district 1 and 9 is in a good condition but urban sprawl is giving its place to these lands. Therefore, northern open spaces must be preserved in order to prevent the negative impacts of urban development process. Based on the analysis, the total amount of open spaces of the region was 28.2 % in 1989 and declined to 11.3 % in 2002. These rates show the destruction of the open space on one hand and on the other hand the increase of the constructions. In other words, the relative density of open space has

decreased by 17%. Open space density gradient in region 2, decreased from north-west to south-east (Tohid roundabout).

The second group of urban green space comprises natural green spaces. The very crucial point that should be mentioned in this part is related to the changes in the natural green spaces in district 8 (Farahzad district) from 1898 to 2002. The relative density of natural green spaces in this district has decreased from 45% to 7%. This process is still going on and a solution must be found to control it. The total natural green space relative density in district 1 in 1989 and 2002 are 8.2% and 2.3% respectively, and these figures show the destruction process of dense gardens and green spaces in region 2.

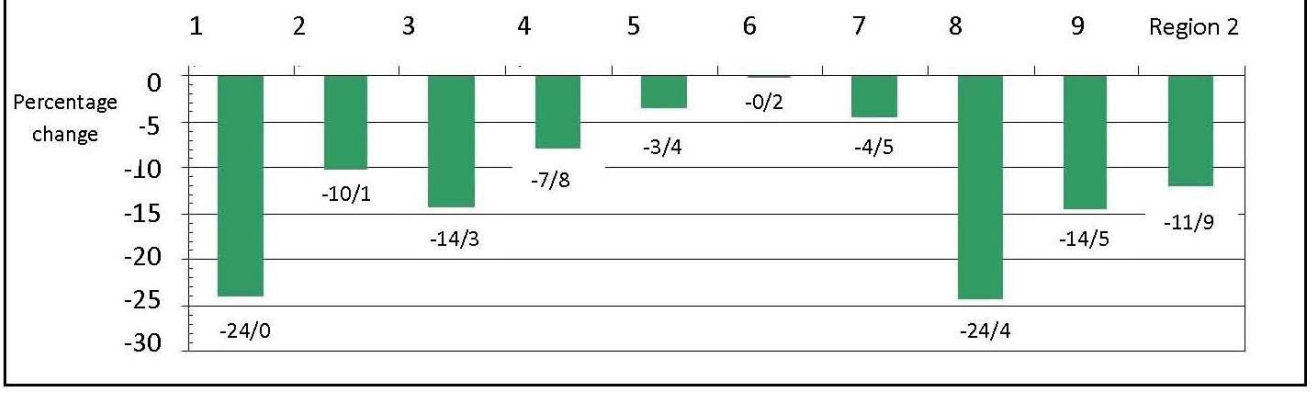
The last category comprises the artificial green spaces. The changes in the artificial green spaces' density from 1989 to 2002 have been positive. Most changes have taken place in districts 2, 3 and 4 due to plantation in Pardisan Park and surroundings. The artificial green space in district 5 has experienced a decline which includes southwest part of region 2 (Azadi district). All in all, the artificial green space density has increased in region 2 (from 1.5 % to 9 %). Figure 5.38 shows the relative density of green and open spaces in region 2 based on 1989 aerial photos analysis. Figure 5.39 shows green and open spaces' density in 2002 in different districts of region 2.

Figure 5.38 : Relative density of green and open spaces in region2 based on 1989 aerial photos



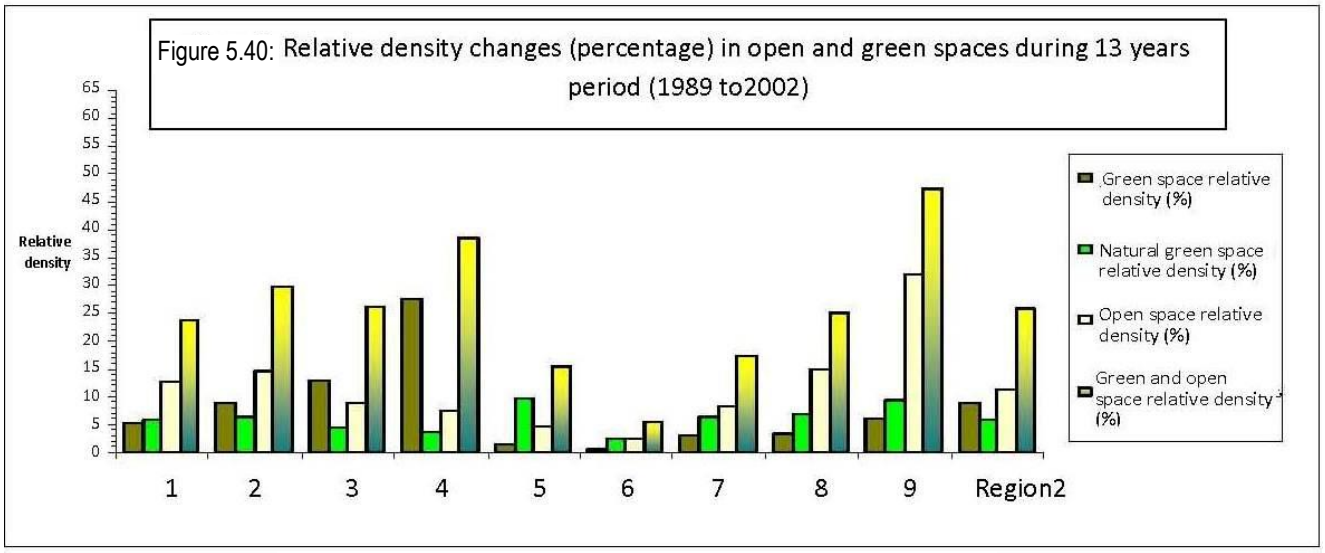
Source: Region 2 Detailed plan, Saravand consulting company, 200

Figure 5.39: Relative density of green and open spaces in region 2 different districts based on 2002 aerial



Source: Region 2 Detailed plan, Saravand consulting company, 2007

Figure 5.40 shows the percentage change of the green and open spaces' density in region 2 in the period of 13 years based on 1989 and 2002 aerial photos.



Source: Region 2 Detailed plan, Saravand consulting company, 2007

The condition of total green and open space area/quality in different districts of region 2 shows different results. The total relative density of the green and open spaces in 1989 is the lowest in district 6 and the highest one in district 9. The difference between the maximum and minimum statistics of region 2 is a considerable 60%. This shows the huge environmental difference between different zones of the region. All together in 1989, the center and the northern zones of region 2 had better green and open spaces density conditions than the southern zones.

Total relative density of green and open space in 2002 (similar to 1989) had the maximum in district 9 and minimum in district 6. However, the total surface areas of green space have decreased in both distrcits.

The most changes in green and open spaces in 1989 and 2002 have taken place in district 8 (Farahzad) and its total green and open space has decreased by 25 %. If this process continues, the tourism-recreational area (Farahzad) will mostly be destroyed. District 1 has the second most changes. All together, most changes have happened in the northern zones of the region (districts 1, 8, 9) and there have to be some policies against this negative process.

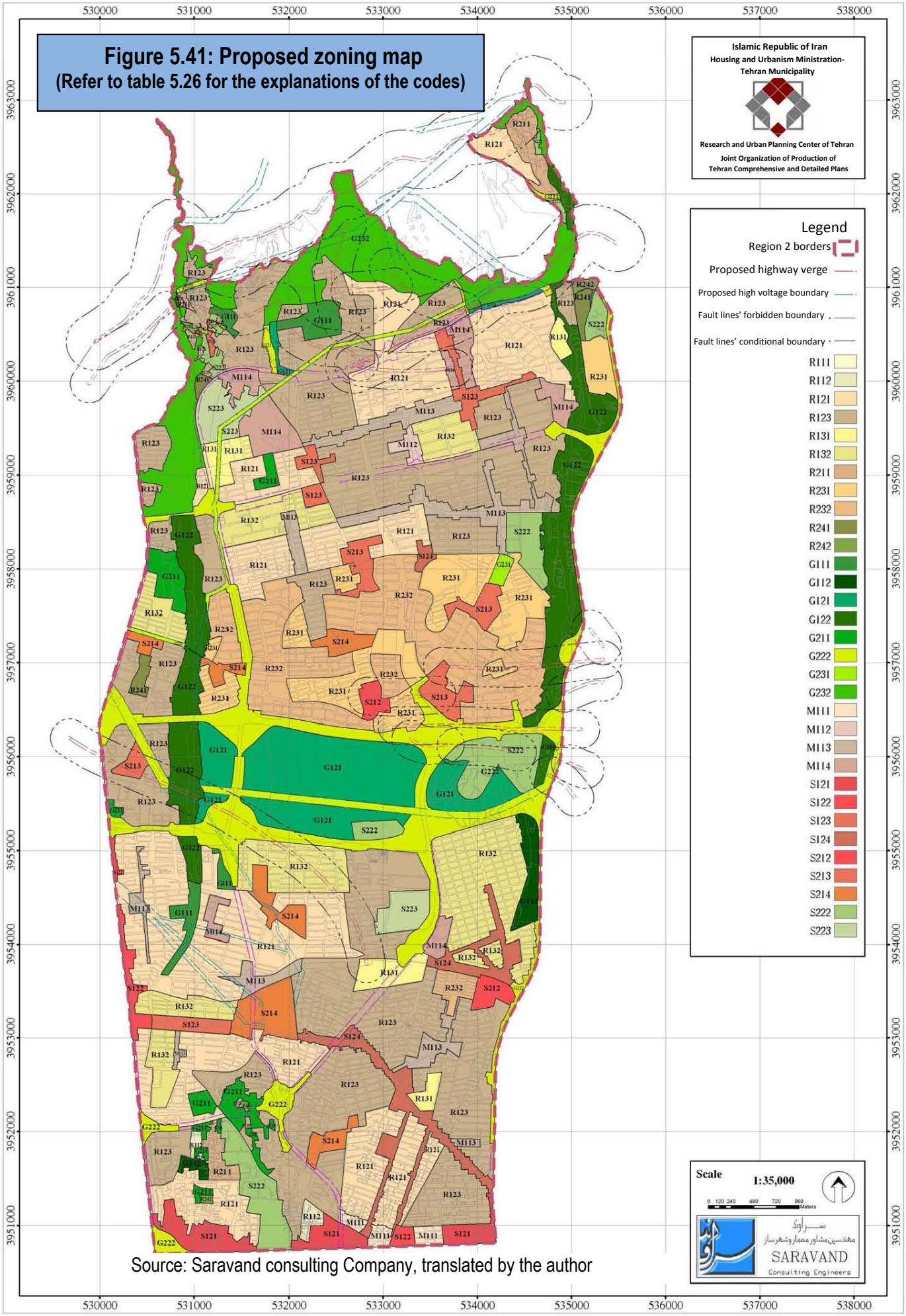
As a conclusion of 1989 and 2002 aerial photos analysis it can be stated that the total gradient green and open space density in region 2 in 1989 and 2002 decreases from northwest to southeast. Therefore two main problems concerning green/open spaces exist in region 2. The first one is decreasing process of green and open spaces quality with urban development**.** This problem is experienced in the northern parts (district 1, 8 and 9) and the center parts (region 3 and 4) of the region. These districts have dense green/open spaces and there should be a preservation approach for the current green spaces in the urban plans by conserving them from being destroyed.

The second problem is the green/open space low density. This problem is experienced mostly in southern districts of the region (district 5 and 6). Due to the poor green space density, population and urban construction in these areas, green space creation approach has to be followed. In these districts any opportunity must be taken to create green spaces.

5.9.7 Zoning

Figure 5.41 presents the zoning map linked to table 5.26 .This map is proposed as a final map by the Detailed plan. Three-code subzones in region 2 Detailed plan are derived from four principles which are the general zones of the Comprehensive plan (residential, activity, mixed, preservation). This method is followed by all Detailed plans according to the regulations. Table 5.26 presents the zones, their areas and the codes in region 2 recommended by the Detailed plan.

Figure 5.41: Proposed zoning map
(Refer to table 5.26 for the explanations of the codes)



Source: Saravand consulting Company, translated by the author

Table 5.26: Areas allocated to 1, 2 and 3-code zones suggested by the Detailed plans zoning

General zone	Area (m^2)	Percentage	1 code zone	Area (m^2)	Percentage From R	2 code zones	Area (m^2)	Percentage from 1 code zone	3 code Zone	Area (m2)	Percentage from 2 code zone
R (Residential)	28292927	56.94	**R1** General residential	22693666.26	80.21	**R11** Low density residential	103004,79	0.45	**R111** Residential with at least 250m2 parcel size	3770.10	3.66
									R112 Residential with at least 200m2 parcel size	99234.69	96,34
						R12 Medium density residential	18922626,7	83,38	**R121** Residential with at least 480m2 parcel size	7901784.93	41,76
									R123 Residential with at least 200m2 parcel size	11020841.77	58.24
						R13 High density residential	3668034.77	16.16	**R131** Residential with at least 2000m2 parcel size	522234.37	14.24
									R132 Residential with at least 600m2 parcel size	3145800.4	85.76
			R2 Special residential	5599260.74	19.79	**R21** Valuable rural residential texture	370442.5	6.62	**R211** one family Residential with at least 150m2 parcel size	370442.5	100
						R23 Valuable contemporary historical residential texture	5011666.73	89.5	**R231** Residential in urban texture with approved plan	1930810.95	38.53
									R232 Residential in non complex buildings	3080255.78	61.47

Table 5.26: Areas allocated to 1, 2 and 3-code zones suggested by the Detailed plans zoning (Continued)

						R24 Garden-residential	217751.51	3.89	**R241** Garden-residential with at least 2000 m2 parcel size	152296.47	69.94
									R242 small sized parcel Garden-residential	65655.04	30.06
S (Activity)	6789192.38	13.66	**S1** Service and commercial activity (commercial dominance)	1999542.88	29.45	**S12** Commercial and service activity corridor	1999542.88	100	**S121** special corridor(high rise)	552405.84	27.58
									S122 Outer regional function	209264.79	10.47
									S123 Regional function	429146.7	21.46
									S124 District and local function	809725.56	40.5
			S2 Service ,commercial and administrative corridor and centers (open and green space dominance)	4789649.5	70.55	**S21** Urban services and corridor and centers with profitable commercial and administrative	1629868.4	34.03	**S212** Outer regional corridors and centers	207457.66	12.73
									S213 Regional corridors and centers	565433.1	34.69
									S214 District and local corridors and centers	856977.64	52.58
						S22 Administrative activities corridor (non-profitable commercial and administrative)	3159781.10	65.97	**S222** Outer regional administrative service and corridors	2682339.75	84.89
									S223 Regional administrative and service corridors	477441036	5.11

Table 5.26: Areas allocated to 1, 2 and 3-code zones suggested by the Detailed plans zoning (Continued)

M (Mixed)	2227263.24	4.48	**M1** Activity and residential	2227263.24	100	**M11** Mixed of commercial and service with residential	2227263.24	100	**M111** Outer regional mixed corridors	149255.69	6.7
									M112 Regional mixed corridors	78228.73	3.51
									M113 Sub regional mixed corridors	1202186.18	53.98
									M114 Mixed corridors with commercial and service dominance	797592.65	35.81
G (Preservation –green and open space)	12381173.88	24.92	**G1** Public green space	6147599.59	49.65	**G11** Urban parks	667579.78	10.86	**G111** Urban parks	405616.74	60.76
									G112 Special parks (recreational parks)	261963,04	39.42
						G12 Forest parks	5480019.81	89.14	**G121** Forest parks	2518021.45	45.95
			G2 Private green space ,special boundaries and zones	623357.29	50.35	**G21** Gardens and agricultural lands	659217.43	10.58	**G122** River-valleys' green spaces	2961998.36	54.05
									G211 Gardens	659217.43	100
						G22 Boundaries	4402103.12	70.62	**G222** Other boundaries	4402103.12	100
						G23 Special zones	1172253.74	18.81	**G231** Historical preservation zones	53305.15	4.55
									G232 Special preservation zones	118948.59	95.45

Source: Region 2 Detailed plan, Saravand consulting company, 2007

5.9.8 Proposed local plans

The plans concerning the subject of this research which are proposed in the Detailed plan of region 2 are as followed: The ecological reconstruction of Farahzad river-valley (155.93 hectares) in third priority; the ecologic reconstruction of Darakeh River-valley (335.85 hectares) in forth priority; river-valley health park (10.97 hectares) in forth priority and the cultural-artistic park (8.96 hectares in Farahzad river-valley) in 14th priority.

5.9.9 Conclusions

Region 2 Detailed plan has been selected as the best among 22 regions because of the exact analysis of green lands and open spaces areas and of the high standards of maps. The studies conducted here can be helpful for the research analysis in some parts. It should be emphasized that on one hand the categorization of green lands is different from the one mentioned in the beginning of this chapter which makes it difficult to use the final statistics. On the other hand, the definition of garden is not clarified. The only reference to this subject is unexplained division of gardens into those with more and less than $2000\mathrm{m}^2$. This classification is not compatible with region 1 Detailed plan either, therefore, it cannot be compared with the figures presented in the last part. Following one definition and the same categories of land uses and urban elements can help the whole Tehran to a better scientific ground, and consequently all further studies can be based on reliable data in the regional scale. However, the calculation in region 2 Detailed plan can once again highlight the necessity of this study and any study allocated to preserving green spaces in Tehran. It proves the first part of this chapter regarding the green field loss in Tehran during the time but as the categories are different, the figures may be different. Nevertheless, they all show very fast negative process and are on one direction. It is clearly written in the Detailed plan that because of this fact, policies should be set against this destructive procedure as will be tried in the final chapter of this study.

According to this Detailed plan the green lands of Tehran have been destructed legally in many parts of region 2. The final results of SWOT analysis state that the environmental issues are dominant in the region. From old valuable river-valley gardens in the north to the Pardisan Park in the center. The highway has destroyed the park and the urban development of road networks will continue destroying the open spaces on the highway verge. Farahzad in the north has lost 25% of its total open and green space in less than 13 years which cannot be compensated by the new artificial green spaces planted in Pardisan Park. Farahzad is an old village core, the ancient character of the region and the environmental filter of that area with huge dense old trees in enormous zones. Its qualifications are very similar to the north part of region 1 (Darband) and the north part of region 5 (Kan). These areas have a regional environmental function for the whole city of Tehran, and losing them affects the whole environmental issues of other regions. One of the characteristics of these districts (Farahzad and Darakeh) which are located in river-valleys is tourism. This can be a potential when having garden-restaurants and can be a threat when new constructions for tourism destroy the gardens in this area. This point has to be strengthened and led in the direction of preservation with tourism activities.

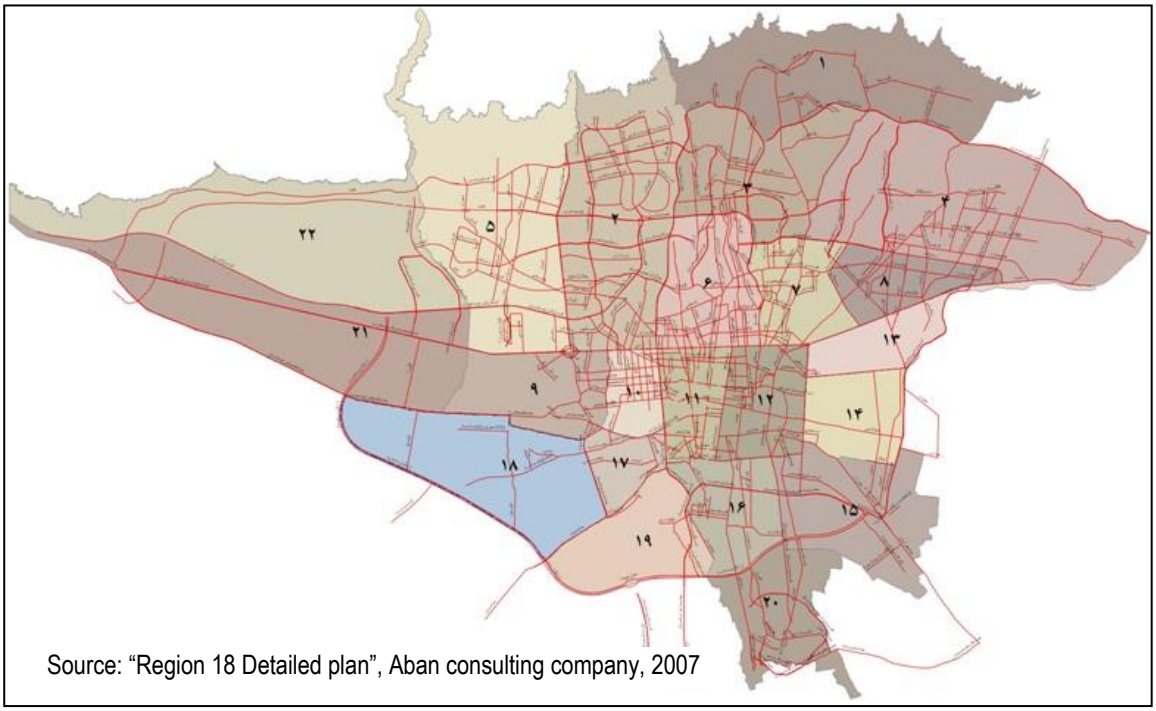
The fast transitional phase of the region from an undeveloped area to high-rises and residential complexes can be well perceived from socio-economic data. The social indexes have been influenced by this rapid development and the immigration of different social levels to this region. Land speculation is one of the consequences of the increment importance of this region in the last decade. Thus, as SWOT analysis confirms as well, there is a loss of balance in environmental factors, an inequity in terms of social circumstances and an enormous cultural contradiction in this area. The combination of these three made complicated arising problems which increased the demand of a space for new constructions. There was either no time to lose and search for the optimal location for the developments or the green lands were not assessed as valuable resources of the city at that time. Moreover, the new residents had very low emotional connection to the place and their main goal was to find an accommodation in relatively good neighborhood of Tehran. One of the reasons that there is a big gap between the north and the south of region 2 stems from these immigrations. The north part comprises more educated people and higher life standards near to region 1. Nevertheless, this fast procedure in region 2 ended up in losing an extensive area of green lands to locate new immigrants. However, it cannot be claimed that the only reason

the green lands have been destroyed in this region is this fast development phase. The problems of the land speculation and the density sale have also emerged in region 2 as same as region 1. Only by taking into account all these aspects can a planner set the policies against green land destruction.

5.10 Region 18 Detailed plan approach concerning urban gardens and agricultural lands

Region 18 is located in the southwest of Tehran and has been added to Tehran in 1980. Figure 5.42 shows its location in the city of Tehran. It has 3783 hectares area and consisted of gardens and agricultural lands decades ago but with Tehran sprawl to the west many of these parcels were covered by urban development.

Figure 5.42: Location of region 18 in Tehran



Source: "Region 18 Detailed plan", Aban consulting company, 2007

5.10.1 Spatial, socio-economic and physical indexes

Region 18 population has increased from 310815 people in 1986 to 364066 in 2007. Population studies show decrease to 296,243 in the decade between 1986 and 1996. But due to some changes in the surface area of this region such as the separation of district 7 and the addition of district 5 to region 18, the population figures in the mentioned years are no longer comparable.

In the first steps of producing the Detailed plan the current land use of 2007 has been mapped. Figure 5.43 shows the current and use of region 18.

Region 18 with 364,066 populations has 4.7 % of the total population of Tehran (reported as 7.7 million at that time). 97,314 people living in this region are in work force which equals only 26.7% of total population of the region.

Gross population density is low comparing to other regions and this is due to the huge agricultural, industrial and garden land uses inside the region. Average building density is relatively low as well which shows the low density, area and height of the buildings in the region. Moreover, when it comes to urban morphology (urban grains) the average size of parcels is 120 m^2 which is relatively small. Table 5.27 shows the above mentioned indexes comparing to the city of Tehran. All together, these indexes in region 18 give an image of a region with large family size parcels which has dense population just in the certain parts, in small parcels with low building density.

Islamic Republic of Iran

Housing and Urbanism Ministration-Tehran

Research and Urban Planning Center of
Joint Organization of Production of
Tehran Comprehensive and Detailed Plans

Region 18 Detailed Plan (2007)

Map Legend

- Region 18 limits
- High voltage power line
- Rail way
- Residential
- Residential Complex
- Commercial
- Educational
- University
- Religious
- Cultural
- Health
- Institutional
- Green space
- Military
- Industrial
- Sand mines
- Urban utilities
- Transportation and warehouses
- Sport
- Undeveloped
- Garden
- Agricultural lands
- Brickwork
- Cattle breeding and aviculture
- Cemetery
- Kan River

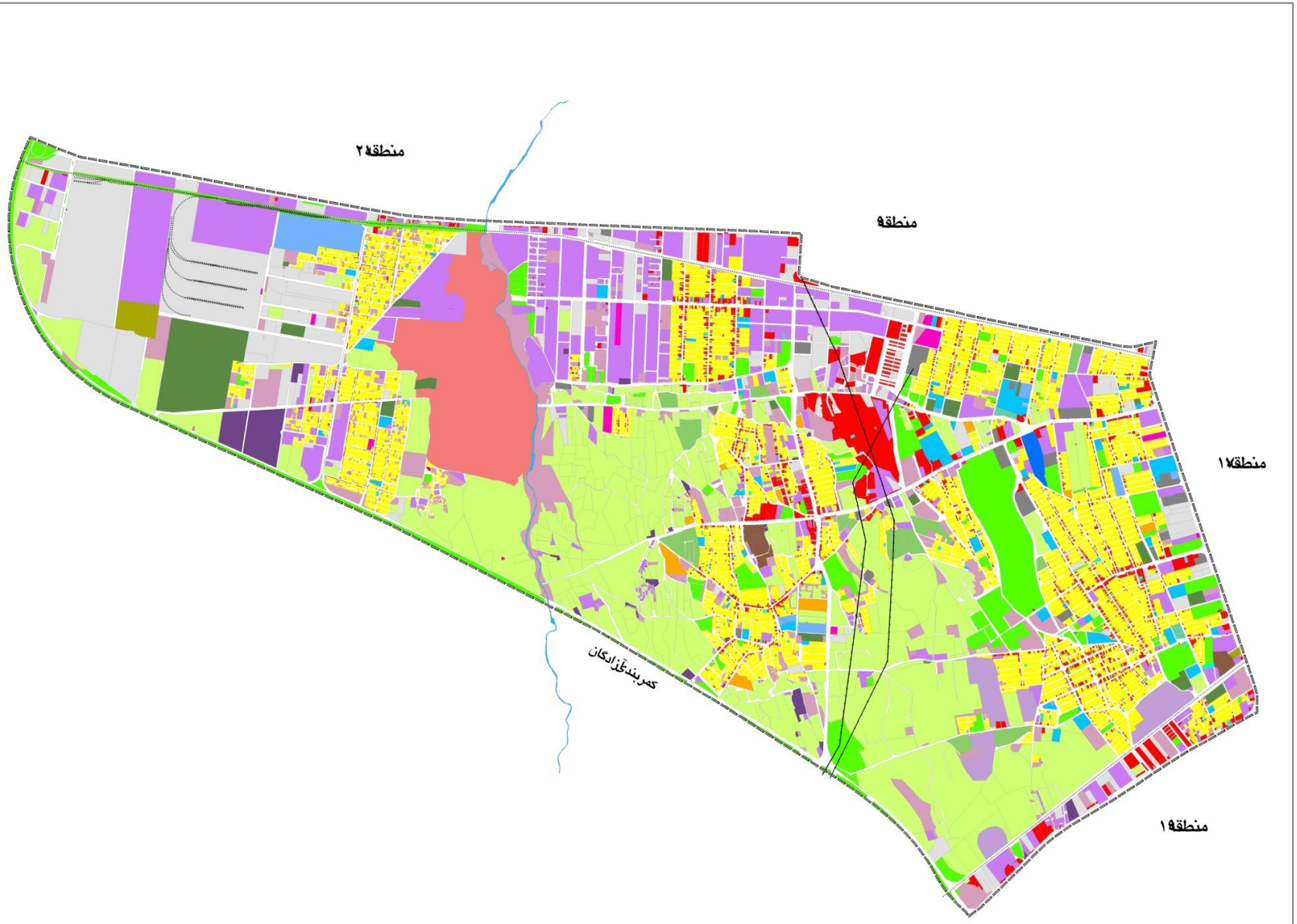
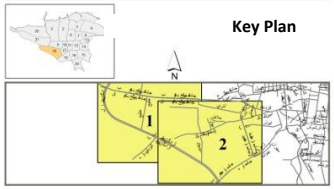


Figure 5.43: Current land use Map

Scale 1:18,000

0 250 500 1,000 2,000 متر

Key Plan



Aban Consulting Company

شماره نقشه:	طراح	کنترل
1	ترسیم	تصویب
	مقیاس	تاریخ
	رشته: شهرسازی	
	شماره دفتر: 85-204	

The Persian names which have not been translated in all the maps are mainly street or neighborhood names and not important for the content of the map.

Table 5.27: Socioeconomic and physical indexes in region 18

Socioeconomic and physical indexes	Region 18	Tehran
Population	364066	7,738,000
Employment	97314	1926000
Family size	4.51	3.26
Number of residential units	73382	1,850,000
Average of residential density	137.5%	164%
Average of residential floors	1.97	2.24
Average area of residential parcels	120	214
Householder per residential unit	1.1	1.24
Gross population density	98	125
Net population density	731	442
Ratio of residents to people in work	3.74	4

Source: "Region 18 Detailed plan", Aban consulting company, 2007

5.10.2 SWOT analysis

The SWOT analysis related to the content of the research has been summarized in table 5.28.

Table 5.28: SWOT analysis of region 18 Detailed plan (status quo)

Strengths	Weakness	Opportunities	Threats
Existence of large vacant parcels in the region which can be used to balance the population density and creating required outer regional services.	Residential units adjacent to industrial/workshop land use	Construction of 3 metro lines in the future in southern part of the region	High tendency to divide parcels in the region boundaries and construct in the population cores
Existence of the industrial land uses and the workshops in the region which prepares the grounds for the employment opportunities	High density and small parcels in the residential texture. Narrow roads and urban distressed areas	Good accessibility to neighboring regions (near Saveh road)	Existence of a fault line in southwest of the region
Existence of the agricultural lands as well as parcels with no land use in the region and the region boundary or adjacent to the green belt.	Inappropriate regional services' distribution and high deficiency of local and district scale services	Existence of industrial land uses and different factories in the neighboring regions	Conflict between transferring the existing factories and "disturbing industries"[1] to out of Tehran and economic dependency of residents to them.
		Decrease of population growth in region 18 and the neighboring regions	

Source: "Region 18 Detailed plan", Aban consulting company, 2007

[1] "Disturbing industries " term is used in Iran urban planning is used as the type of industries with high pollution which should not be adjacent to urban-residential areas and must be transferred to out of the city. In contrary another term is 'non-disturbing industries which are environmentally compatible with urban areas and can be located inside the cities.

5.10.3 The main issues of the region

The main issues of the region have been listed by the Detailed plan as follows:

- The lack of solidarity in the urban texture and as a result the separation between residential texture of the region
- The lack of road and connectivity network inside the region. The current road status is 14 % of the whole region surface area.
- The existence of irrelevant outer regional land uses adjacent to residential land uses such as Iron market (140 hectares) with warehouses and workshops, industrial district in the north part of the region with 241 hectares.
- The existence of greenbelt parcels in the south, center and the west of the region that are the main reason of separation in the urban texture.
- The parcels adjacent to Kan River and the sand mine of 20-70 m depth cause accessibility problems between west and east (312 hectares).

5.10.4 The development pattern of the region

The following results have been presented to guide region 18 developments; the west lands of Kan River which had been used as sand mine for several years and have turned into a scar in the landscape in the city entrance, have been under local projects.

Industrial zones are the main economic source of the inhabitants in this region and without them there will be big unemployment problems. Thus the polluting factories and activities should give way to environmental friendly activities and workshops (non-disturbing industries).

Currently region 18 does not have a functional center and regional services have spread non- concentrated in the region. This Detailed plan has turned a part of the central districts of the region into the “Region center”. This is where Iron market in Region 18 vision has recommended that a part of the central lands of the region which are mostly agricultural lands, gardens and the greenbelt are to be allocated to these activities.

Currently the southwest part of Tehran greenbelt is located in region 18 which causes a separation in the urban texture. It is also recommended to transfer the greenbelt to Azadegan highway verge and spread region 18 new limits to this highway. Figure 5.44 shows the development pattern of the region 18.

5.10.5 Region 18 population in the Detailed plan vision

Region 18 has been divided into 5 districts and 18 neighborhoods. Future population has been forecast by taking these factors into consideration: Future residential areas; number of the residential units; household per unit and the family size.

As a result the total population in the Detailed plan vision will be 557,153 by 2021. The lowest gross population density of the region is 107,66 persons per hectare in district 5 and the highest one is 248,25 persons per hectare in district 3. All in all, the total gross population density of region 18 with 3720.74 hectare area will be 149.74 per hectare in the Detailed plan vision.

5.10.6 Road network and land use zoning

One of the main approaches of Detailed plan is to develop, optimize and complete the road network of the region and make connectivity between region 18 and other regions. Thus, this network should be improved. The main elements of the new network consist of highways with 168.37 hectares and 21.08 % of the total network; major arterials with 39.4 hectares and 4.94% of the total network; minor arterials with 155.46 hectares and 19.45% of the total network and the collector streets and other local streets with 435.77 hectares and 54.54% of the total network. The total surface of accessibility network is 799 hectares. Figure 5.45 shows the current road network while figure 5.46 shows the recommended network by the Detailed plan explained above.

Islamic Republic of Iran
Housing and Urbanism Ministration-Tehran

Research and Urban Planning Center of Tehran

Joint Organization of Production of
Tehran Comprehensive and Detailed Plans

Region 18 Detailed Plan (2007)

Map Legend

- Recommended Region limits
- 25 years Tehran limits
- Previous Comprehensive plan limits
- Adjacent regions
- Outer –regional road network
- Current and recommended road network
- Current land use
- Current industrial land use
- District Services
- Outer-regional park
- Outer regional Sport
- Outer regional hospital
- Outer regional iron market
- Special outer regional service
- Outer regional, transportation
- Region center service
- Greenbelt
- Kan river
- Residential (first priority)
- Residential (Second priority)

Figure 5.44: Development Pattern of region 18

Scale

Key plan

Aban Consulting
Company

Figure 5.45: Current road network of region 18

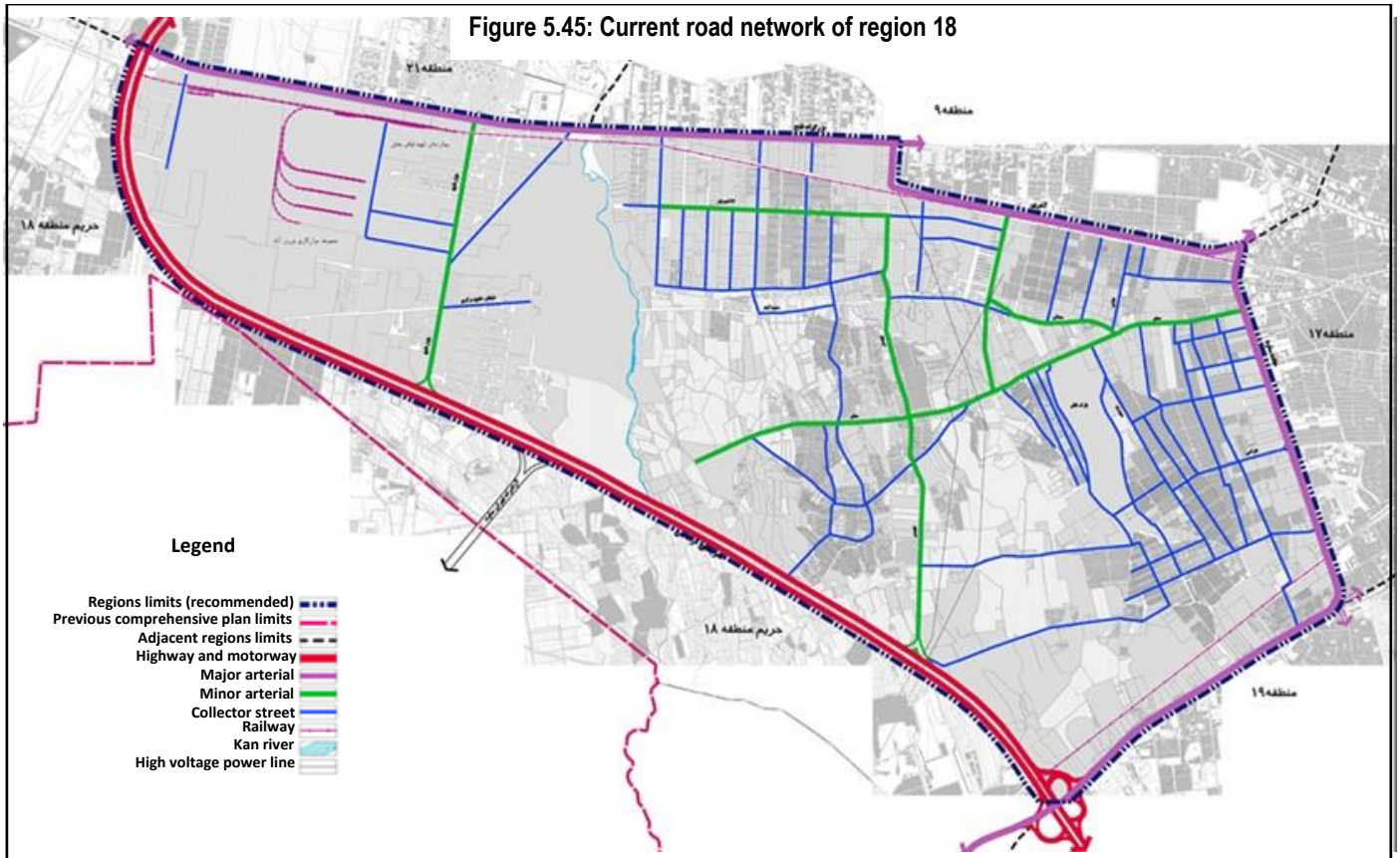
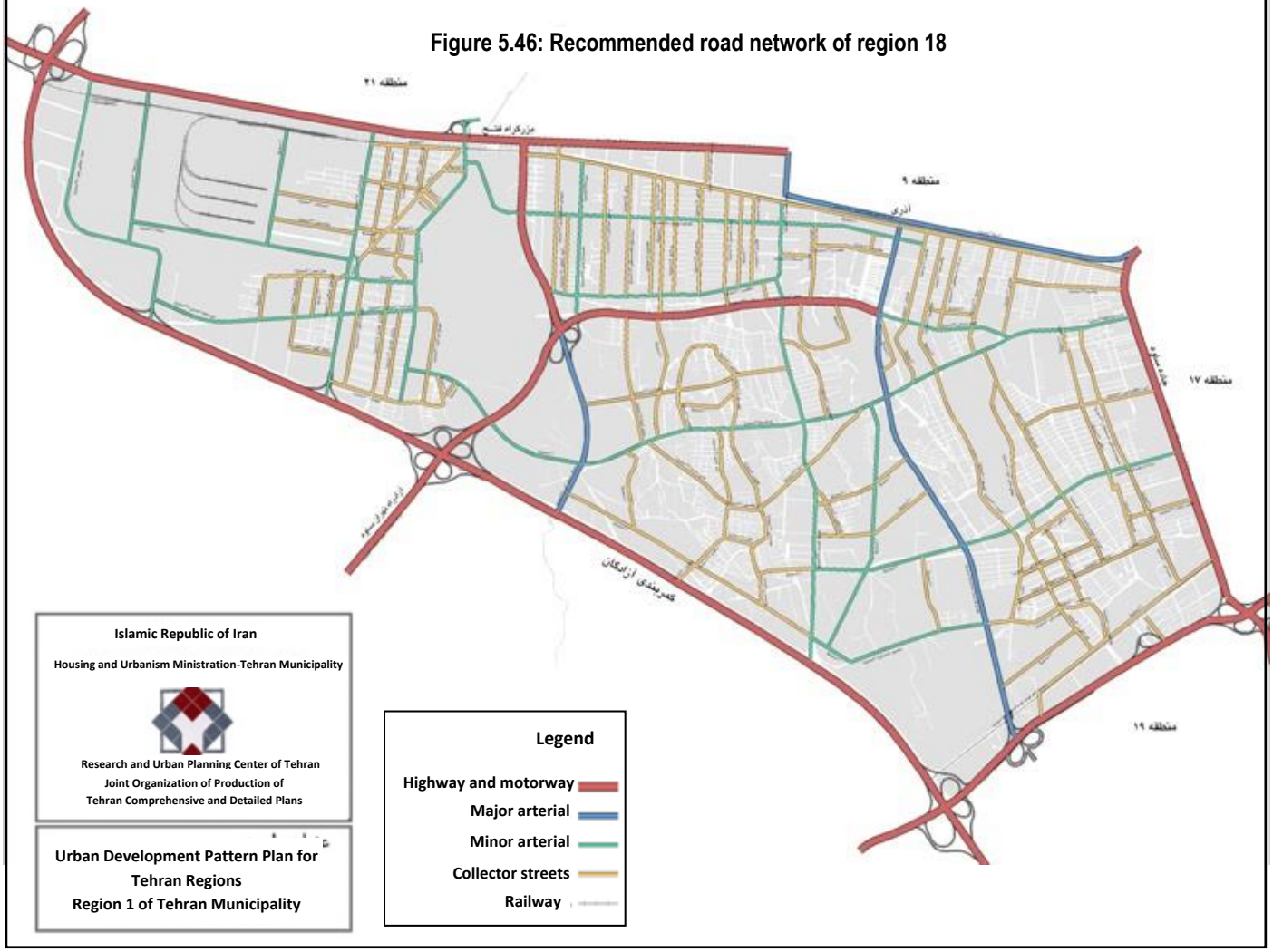


Figure 5.46: Recommended road network of region 18



Source: Aban consulting Company translated by the author

Islamic Republic of Iran

Housing and Urbanism Ministration-Tehran

Research and Urban Planning Center of Tehran

Joint Organization of Production of Tehran Comprehensive and Detailed Plans

Region 18 Detailed Plan (2007)

Map Legend

Region 18 limits

High voltage power line

Rail way

Urban development and renovation reserve

Local plans

G111	G232	S123	S223
G122	M114	S124	S224
G211	R112	S212	S322
G212	R122	S213	S332
G221	R132	S214	
G222	R262	S222	

The above codes are explained in tables 5.29 and 5.30.

Figure 5.47: Land use Zoning

Scale 1:18,000

0 500 1,000 2,000 متر

Key plan

N

1 2

Aban Consulting Company

شماره نقشه: 3

طراح	کنترل	
ترسیم	تصویب	
تاریخ	تاریخ	
رشته: شهرسازی		
شماره طرح: 85-204		

In the first step of the land use zoning the relevant zones will be highlighted which means the neighboring zones without disturbing each others' functions. In the second step, the permitted land uses in each zone will be determined. The whole region of 18 is divided into 4 main zones (R, S, M, G) followed by the Comprehensive plan standards. From 3720.74 hectares of the region, 27.67% is allocated to residential zone (R), 47.03% to activity zone (S), 41% to mixed use zone (M) and 24.89 % to preservation zone (G). Table 5.27 shows the zones and their areas and subzones in region 18. Table 5.30 is used as a guidance to clarify the codes in table 5.29 and figure 5.47 which shows region 18 land use zoning.

Table 5.29: Zones and subzones areas in region 18 zoning map

General zones	Main zones			Subzones			Subzones (3 codes)		
	1code zone	Area (hec)	Percentage	2codes zones	Area (hec.)	Percentage	3 codes zone	Area (hec)	Percentage
Residential (R)	R1	985.48	26.48	R11	93.43	2.51	R112	93.94	2.51
				R12	721.02	19.38	R122	721.02	19.38
				R13	171.03	4.59	R132	171.03	4.59
	R2	44.18	1.19	R26	44.18	1.19	R262	44.18	1.19
Activity (S)	S1	97.3	2.61	S12	97.3	2.61	S123	86.84	2.33
							S124	10.46	0.28
	S2	112.5	30.17	S21	682.16	18.33	S212	309.36	8.32
							S213	327.27	8.79
							S214	45.53	1.22
				S22	440.34	11.84	S222	252.85	6.8
							S223	175.08	4.71
							S224	12.41	0.33
	S3	529.99	14.25	S32	258.4	6.94	S322	258.4	6.94
				S33	271.59	7.3	S332	271.59	7.3
Mixed (M)	M1	15.2	0.41	M11	15.2	0.41	M114	15.2	0.41
Preservation (open and green space (G)	G2	581.52	15.63	G21	220.24	5.92	G211	5.02	0.13
							G212	215.22	5.79
				G22	130.06	3.49	G221	35.28	0.95
							G222	94.78	2.55
				G23	231.22	6.21	G232	231.22	6.21
Total		**3720.74**	**100**		**3720.74**	**100**		**3720.74**	**100**

Source: "Region 18 Detailed plan", Aban consulting company, 2007

Table 5.30: Land use zoning structure in region 18

General zones	1 code zone	Zone	2 code zone	Subzone	3 code zone	Subzone classification according to certain characteristics
Residential (R)	R1	General residential	R11	Low density residential	R112	2,3 floor residential unit with minimum parcel size of 200 m2
			R12	Medium density residential	R122	3,4 floor residential unit with minimum parcel size of 300 m2
			R13	High density residential	R132	5 floor residential unit with minimum parcel size of 600 m2
	R2	Special residential	R26	Special residential along urban corridors	R262	Up to 9 floors residential with minimum parcel size of 1000m2
Activity (S)	S1	Commercial and service activity (commercial dominance)	S12	Working ,service ,commercial activities	S123	Regional function
					S124	District and local function
	S2	Service ,commercial centers and districts(green and open space dominance)	S21	Centers and districts of urban service, with commercial and institutional activities	S212	Outer regional service centers and districts
					S213	regional service centers and districts
					S214	District scale /local service centers and districts
			S22	Institutional(non profit) centers and districts with service and commercial activities	S222	Outer regional service and institutional districts
					S223	regional service and institutional districts
					S224	Local service and institutional districts
	S3	Industrial and workshop	S32	Workshop /industry corridors	S322	Productive and commercial workshops
			S33	Service industry	S332	Mixed districts with service and commercial land use
Mixed (M)	M1	Activity with residential land use	M11	Mixed of service and commercial land use with residential buildings	M114	Mixed districts with commercial and service dominance
Preservation (G)	G1	Green and public spaces	G11	Urban parks	G111	Urban parks
			G12	Forest parks	G122	Green spaces of river-valleys
	G2	Private green spaces, special zones, boundaries	G21	Gardens and farmlands	G211	Gardens
					G212	Farmlands
			G22	Boundary zones	G221	Riparian zones
					G222	Other boundary zones
			G23	Special zones	G232	Other preservation zones (greenbelts)

Source: “Region 18 Detailed plan”, Aban consulting company, 2007

Table 5.31: Residential subzones characteristics of region 18 (division/construction regulations)

3 code subzones	Building density		Occupancy index	Minimum of parcel size(m2)	Suitable road width	Number of floors	Minimum number of unit per hectare	Ratio of residents to people in work
	Current	recommended						
R112	Average of current building density in the whole region is 137.5 %	120%	40%-60%	200	More than 6 meters	2-3	150	70%
R 122		180%	45%-60%	300	10-12 meters	3-4	200	70%
R132		225%	45%	600	More than 12 meters	5	250	70%
R262		270%	30%	1000	More than 24 meters	9	270	70%

Source: "Region 18 Detailed plan", Aban consulting company, 2007

Table 5.31 shows the construction regulations concerning residential units in (R) zone. As mentioned in previous sections the second step in land use zoning is to clarify the permitted land uses in each described zone. Table 5.32 has divided all the land uses into four main categories: residential, nonresidential, green and boundary zones and mixed. Then the list of the permitted land uses in each mentioned category is presented.

Table 5.32: Land uses in each zone in region 18

Land uses				Zones			
Main Land use	Area (hec.)	Percentage	Land use	Main Land use	Area (hec.)	Percentage	subzones
Residential	498.72	13.4	Low density	Residential buildings with road network and service	1029.66	27.7	R1 general R
			Medium density				R2 special R
			High density				
Non residential	2093.72	56.3	Educational	Activity with road network	1749.79	47	Service, commercial and institutional centers/districts(green and open space dominance) (S2)
			Cultural-religious				
			Sport				
			Commercial				
			Health				
			Institutional				
			Transportation				
			Urban utilities				Industrial-workshop land uses (S3)
			Road network				
			military				
Green and boundary zones	1128.3	30.3	Green space-agriculture-boundary zones	Preservation (open and green) containing roads	926.1	24.9	Public green spaces (G1)
							Private green spaces-special boundaries and zones (G2)
Mixed	-	-	Residential with work	Mixed land use with roads	15.2	0.4	Mixed and activity and residential land uses(M1)

Source: "Region 18 Detailed plan", Aban consulting company, 2007

5.10.7 Seven urban services[1] and green spaces (current and required)

Urban services and green spaces have been all calculated in each district of the region according to the Comprehensive plan standards of per capita. In this section the required services will be presented based on previous district studies. All in all, region 18 has 227.39 hectares urban service deficiency. From this number, 83.37 hectares are regional service and green space deficiency, 72.02 hectares at district scale and 73 hectares at local one. Through fulfilling these deficiencies, governmental lands, private undeveloped parcels and agricultural lands could be used. Table 5.33 shows current and required urban services in various scales in region 18.

Table 5.33: Current/required urban services (regional, district and local scale)[2]

Urban services	Regional services (hec)			Services at district scale (hec)			Local services (hec)			Total Services (hec)		
Green space and park	Current	Required	Deficiency	Current	Required	Deficiency	Current	Required	Deficiency	Current	Required	Deficiency
	56.37	111.43	55.06	62.75	83.57	20.82	27.5	55.71	28.21	146.62	250.71	**104.09**
7 urban services	110.98	139.2	28.31	37.94	89.14	51.2	23.21	78	44.79	182.13	106.43	**124.3**
Total	167.35	250.72	83.37	100.69	172.71	72.02	60.71	133.71	73	328.75	557.14	**228.39**

Source: "Region 18 Detailed plan", Aban consulting company, 2007

Thus service deficiencies in region 18 are in these 3 groups: green space deficiency around 104.09 hectares, urban service deficiencies about 124.30 hectares and total of green space and service deficiencies which are 288.39 hectares. Figure 5.48 shows public services and green space land uses in region 18.

5.10.8 Local plans in region 18 Detailed plan

Among all local plans the one that relates the subject of the research is "Special plan of lands adjacent to Kan river". All the local plans are shown in figure 5.49 .The numbers on the map show the plan priority. These plans show in which directions of function the region will develop in future.

[1] Educational ,health, cultural ,recreational, ,sport ,religious and urban facilities explained in 5.7.8

[2] The standards are according to the recommended land use per capita standards in Tehran Comprehensive plan 2007.

Figure 5.49: Local Plans of Region 18

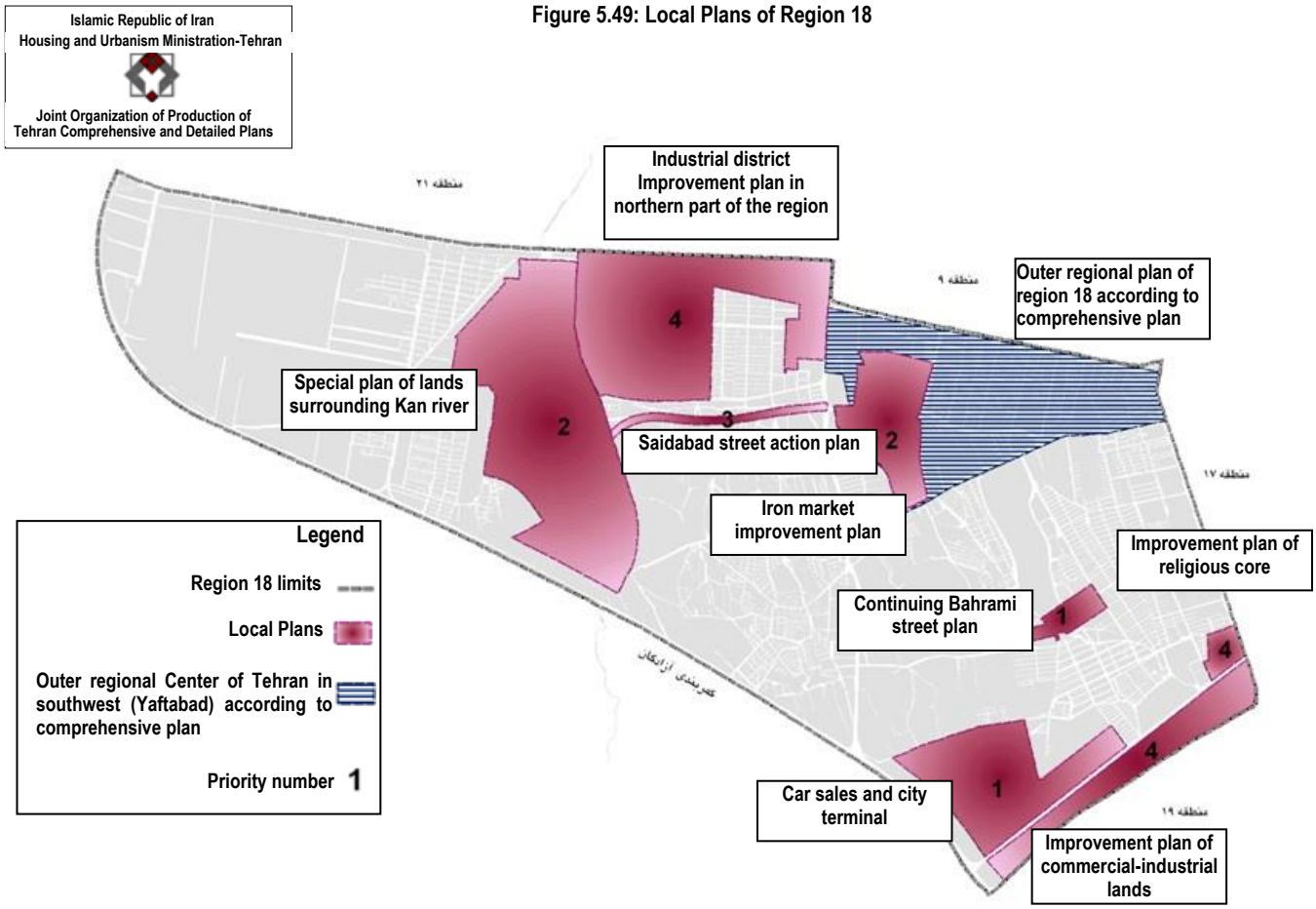
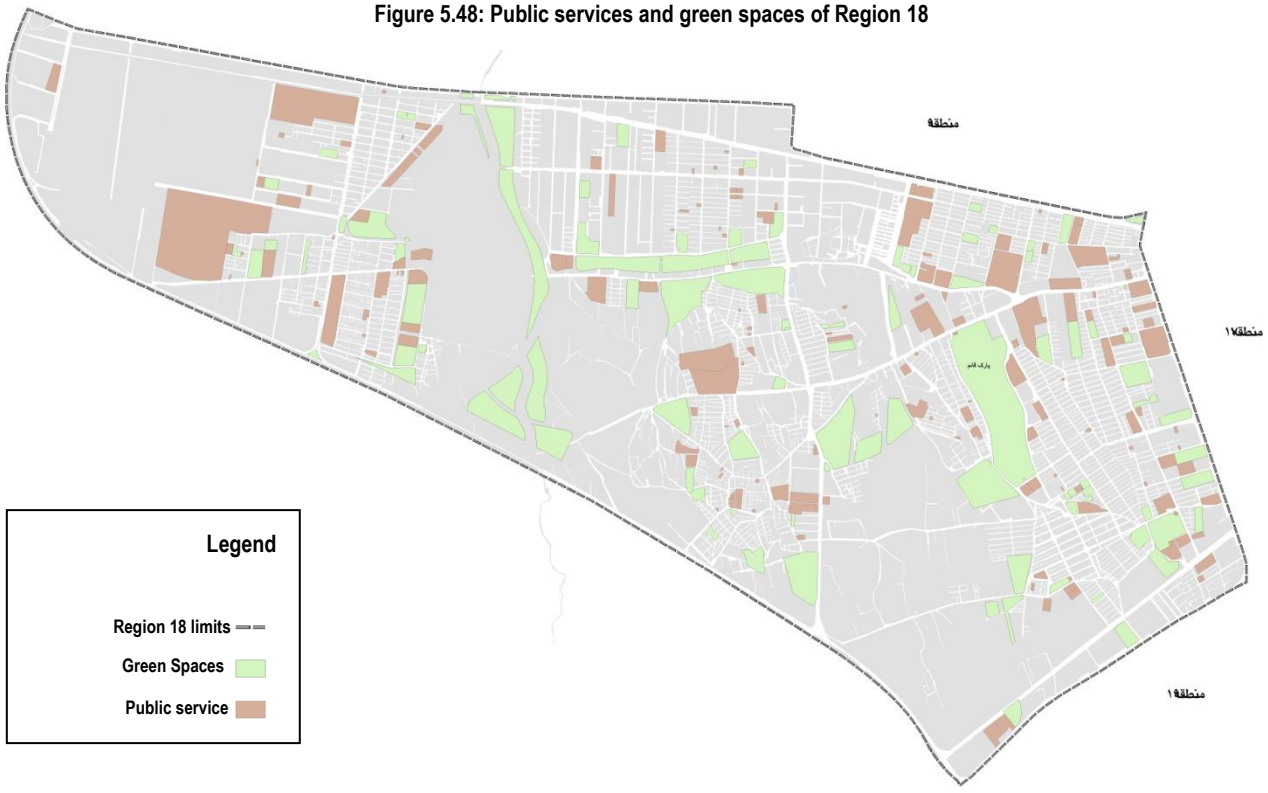


Figure 5.48: Public services and green spaces of Region 18



Source: Aban Consulting Company translated by the author

5.10.9 Conclusions

Region 18 Detailed plan is very focused on the zoning and the process of making zones from land uses according to the Comprehensive plan. This approach has been successful between all Detailed plans and it indicates that it can be implemented for other concepts and parts which have to be done on a big scale of Tehran. Green lands preservation could have been successful if it has been considered with the same definition in the Master plan and then followed by all the Detailed plan.

Although region 18 is characterized by its agricultural land as is region 1 by its gardens, in region 18 Detailed plan this character has not been outstanding like region 1 and in many parts it has given the same value as a normal urban land use. Following this approach ends to the lack of policies, local plans and strategies to preserve these valuable lands. Tagging a land use as a preservation zone is not the only solution which can preserve it in reality. Moreover, green space, agricultural lands and boundary zones sum up to a total of 30.3% of the area of the region, whereas the two codes G211 and G212, allocated to garden and agricultural preservation zones, produce only a percentage of 5.92%. The calculations are not clear enough to justify the reason that such an enormous amount of green land has been decreased in zoning. The only possible answer by taking the calculation into consideration can be if the area is allocated within the boundary zones. However, by checking the status quo with the proposed zones, it become clear that there have been many agricultural open spaces which have been proposed as R122, S212 and S213 thus referring to residential, outer-regional and regional services. Therefore, the 25% of these lands which are missing in the calculation and did not turn to preservation zone (G) will be destroyed according to the legal urban plan.

According to the Detailed plan there is a remarkable lack of green space in the region (104 hectares) which requires policies and plans to be provided. Nevertheless, the Detailed plan approach is not to preserve and strengthen the density and quality of the existing green spaces, but rather to develop the new green spaces. Whereas using the existing fields is easier and requires less financial support.

In spite of the ecological approach of this study, the balance between all different dimensions of sustainable development has been taken into consideration. In the Detailed plan the conversion of polluting industries to non-disturbing ones have been recommended which is a big ecological achievement. In contrary, it has been mentioned that industrial zones are the main economic source of the inhabitants and without them there will be big unemployment problems. In other words, the suggested environmental progress is neglecting the socio-economic conditions of the region. A sustainable development can only be successful when all its dimensions are in balance and well developed. Now this question arises that the balance between different dimensions of the sustainable development has to be limited to a specific region or all Tehran has to be considered when evaluating the balance. In other words, can the deficiencies in a region be compensated by the other region and the entire Tehran stays in balance? The other option is that each region has to solve its own problems to keep the balance at regional scale. Answering this question clarify the path to the recommendations and proposals in chapter 7.

5.11 The main outcomes of the Iran urban plans

By studying Tehran Comprehensive plan and the three Detailed plans, Iranian urbanism and planners mentalities can better be understood. Since green lands destruction is an urban issue as well, this closer view on urban plans is definitely advantageous for setting further policies. In general, the contents of the plans are not in low standards but the place and its problem have not been taken into consideration as much as it has to be. In other words, our cities are not international cities to be conducted by international plans.

The Comprehensive plan gives an idea of the Tehran expansion and development, whereas the Detailed plans are the complete documents to analyze each region specifically from different points of view. Socio-economic, cultural, ecological and urban characteristics of the region are thoroughly explained and discussed. On one side, they can be the basis for any other urban research and on the other side, they are the legal official upper-hand documentations for any further recommended projects which gives them a high importance. However, in most cases they do not contain realistic suggestions for the city. The feasibility of the statements is not as significant as

analyzing the status quo. There is a common characteristic in almost all these plans which is the incapability of using the potentials of the regions in the progressive track to develop constructive policies. They are quite vigorous plans in terms of describing and analyzing the current conditions but when it comes to planning and suggestions, they ignore the first parts and the potentials as much as the SWOT analysis they have already implemented. Therefore, a strong and convincing leading thread from the beginning to the end cannot be found in the whole chapters of the plans.

The second point is that there is a lack of multidimensional approach in most of the plans. In spite of the fact that a Detailed plan discusses all dimensions of the city, it has to take all this dimensions forward to the end and come to multidimensional suggestions which try to keep every part of the region in balance. However, somewhere between SWOT and final local plans, this thread is torn as well.

The other fact is that the hierarchical urban plans should not just follow the hierarchical scale but rather the content. They have to give new ideas by observing the upper-scale plans and by using them as the fundamental theoretical basis to prepare their grounds. This can be seen in the urban projects; there is in many cases a section in the researches or projects relating the contradictions between the plans in one scale or two different ones and the contradictions prepare a suitable ground for any fraud or destruction.

At the end it has to be emphasized that the plans have to have the power to be executed. This depends on two sides. First, it is the plan itself which has to comprise feasible and realistic items by taking into consideration the economic condition of the executive authorities. Second, is the authorities/governmental supports to execute whatever they have approved in the plans. The existence of too many Commissions alongside the plans weakens the powerful position they have to have in the urban development and at the end the urban plans with so many direct and indirect costs caused will turn into nothing more than theoretical papers ready.

6 Criteria and Methodology

In this chapter the criteria extracted from the previous chapters will be discussed and categorized. Thereafter the methodology based on this outcome will be adjusted and implemented.

6.1 Sustainable development methodologies and frameworks

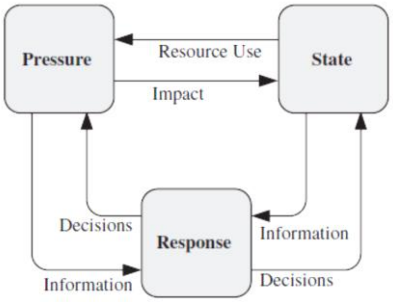
"Environmental assessments have become an important tool in planning and evaluation at all scales of decision-making. This has led to a boom in environmental (sustainability) assessment reports based on the use of environmental indicators." (EEA, 1999, 2001; EPA, 2003 quoted after Niemeijer and Groot, 2008, P.90) "Providing rational and logical structures, policy frameworks present a platform in which indicators can be identified and classified, for every purpose" (OECD Environment Directorate, 2004 quoted after Meyar- Naimi et al., 2012, p.351). "Organization of Economic Cooperation and Development (OECD) defines indicators as the values that give information about the situation of a system, and simplify the communications of its components "(Kemmler and spreng, 2007 quoted after Meyar- Naimi et al., 2012, p.351).

"Numerous conceptualization methods and frameworks have been developed that can be applied under the broad area of sustainability assessment (cf. Ness et al., 2007; Bammer, 2005; Parris and Kates, 2003b). These approaches include e.g. causal loop diagramming (Richardson, 1991; Richardson and Pugh, 1981; Roberts et al., 1983), the soft systems methodology (Checkland, 1991), flow diagrams and mental mapping (Klijn, 2004), the institutional analysis and development (IAD) framework (Ostrom, 2005; Andersson and Ostrom, 2008) and policy analysis frameworks (White, 1979; Roe, 1997; O'Laughlin, 2004)." (Ness et al., 2010, p.479)

"Many studies try to use indicators to track systems progress towards the Sustainable Development goals and refer them as Sustainable Development Indicators (SDIs)" (Afgan et al., 2000; IISD, 1995, 1997, 1999, 2004, 2005; World Bank, 2002 quoted after Meyar- Naimi et al., 2012, p.351).Using SDIs, the spatial and temporal trends of a system state can be evaluated, its future conditions can be predicted and a set of warning signals can be provided. Review papers have been published to present integrated accounts of the SD methodologies, frameworks and indicators. Several SD policymaking frameworks have been developed in various fields, including energy, environment and health mainly by international organizations. Their main differences come from their subjects of policy making and assessment and the inter-linkages between their components. For instance, OECD framework mainly emphasizes sustainable environment development and associated dimensions like economy, society and politics (Nathan and Reddy, 2008 quoted after Meyar- Naimi et al., 2012, p.352).

"These frameworks are also called causal chain frameworks by some researchers such as Niemeijer and Groot in 2008. In particular, the current frameworks, through their emphasis on causal chains tend to induce a somewhat narrow, issue-centered perspective on the environment. For each environmental issue (e.g., acidification, desertification) a causal chain is identified with one or more indicators at the cause-end and at the consequences-end of the chain" (Swart et al., 1995 quoted after Niemeijer and Groot, 2008, P.90). "Obtaining better insight into the interaction between indicators is useful in several ways: it highlights the true complexity of environmental interactions; it can help identifying key indicators thereby reducing the number of indicators necessary for environmental reporting; jointly, this can lead to more efficient indicator-based reporting and better decision-making" (Niemeijer and Groot, 2008, P.90).

Figure 6.1: PSR framework



Source: Meyar- Naimi et al., 2012, p.352

6.1.1 Different policy making frameworks

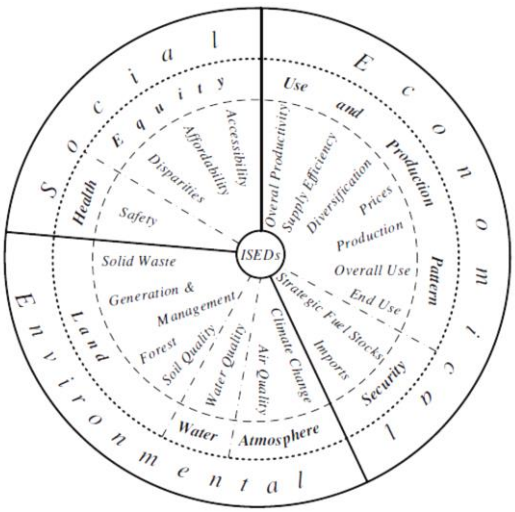
There have been different types of policy making/sustainable frameworks which developed during the time. Here, the most well-known ones and their development process will be discussed.

"The first framework, the Pressure–State–Response (PSR) framework (Figure 6.1), is based on a study by the OECD, Canadian government and UNEP" (Hammond et al., 1995, p.11 quoted after Niemeijer and Groot, 2008, P.92). This framework divides indicators in pressure, state and response indicators through the following logic: "... pressure on the environment from human and economic activities, leads to changes in the state of environmental conditions that prevail as a result of that pressure, and may provoke responses by society to change the pressures and state of the environment" (OECD, 1999a, p.12 quoted after Niemeijer and Groot, 2008, p.92).

"The PSR framework consists of three components, i.e. Pressure, State and Response. Pressures on environment are due to human activities such as exploration, exploitation and especially consumption of energy resources in different sectors (OECD Environment Directorate, 2004). States describe the conditions of natural resources, ecosystems and human health. Responses comprise the preventing, precautionary and awareness activities in environmental, economical and social sectors" (Meyar- Naimi et al., 2012, p.352).

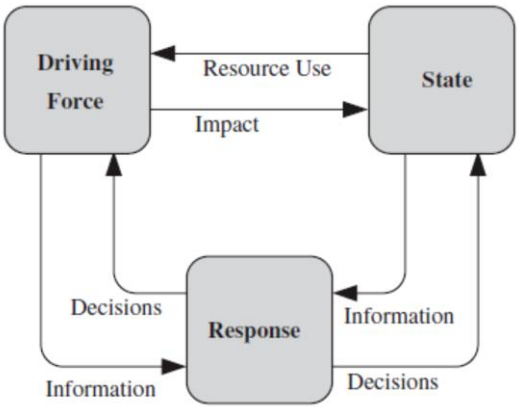
The second framework, also used by the OECD, is the Driving force–State–Response (DSR) framework. This framework is used for the OECD's work on environmental indicators for agriculture (OECD, 1999a, 1999b, 2001a quoted after Niemeijer and Groot, 2008, P.92). DSR framework is developed by the United Nations Commission on SD (UNCSD) to provide a consistent set of indicators and to assess progress towards a sustainable energy future (DSD-UNDESA, 1998, 2001a, 2001b; Vera and Abdalla, 2005b quoted after Meyar- Naimi et al., 2012, p.352). The effort has been reinforced by the International Atomic Energy Agency (IAEA) in 1999–2005 by developing an original set of Indicators for Sustainable Energy Development (ISED), and then implementing them as shown in figure. 6.2 and tested in 15 countries (IAEA et al., 2005; Vera et al., 2005a, 2005b; Vera and Langlois, 2007 quoted after Meyar- Naimi et al., 2012, p.352). In this case the "pressure" component is replaced with the concept of "driving forces". (Figure 6.3) This concept, in the words of OECD (1999a, p.14), "recognizes that agricultural activities can both produce beneficial impacts to enhance environmental quality, for example by increasing the water storage capacity of certain agricultural systems which may ameliorate problems of soil erosion, landslides and flooding, and also have harmful impacts on the environment, such as the excessive use of fertilizers and pesticides and inappropriate management practices." The concept of driving forces also accommodates "a broader coverage of the influences affecting the environment in agriculture and sustainable agriculture, including farmer behavior, government policies, economic, social, and cultural factors" (OECD, 1999a, p.14 quoted after Niemeijer and Groot, 2008, p.92).The Driving Forces include human activities that have an impact on the sustainability of a system State like the conditions of the environmental and natural resources. The Responses include the legislation, regulation and so on. (Naimi et al., 2012, p.353)

Figure 6.2: Proposed ISED by IAEA



Source: IAEA et al., 2005 quoted after Naimi et al., 2012, p.353

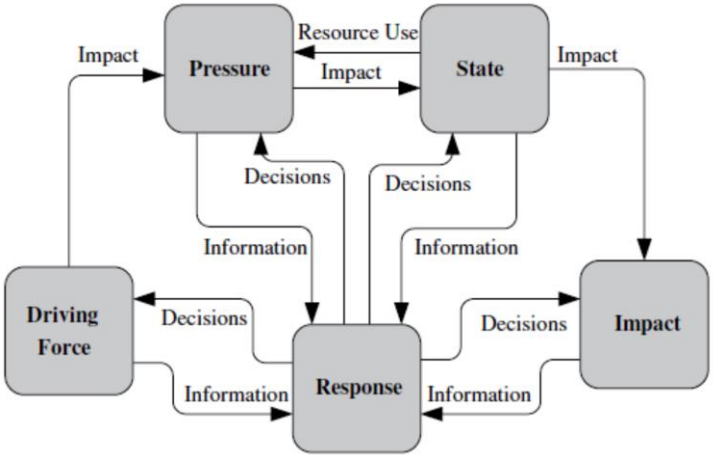
Figure 6.3: DSR Framework



Source: Naimi et al., 2012, p.353

In 1999, PSR model was modified by European commission through the EEA and Eurostat to construct the Driver-Pressure-State-Impact-Response (PSIR) framework and analyze the environmental problems (Jago-on et al., 2009). Afterward, the European commission, Eurostat and EEA have developed a number of energy indicators, which aimed at the reassurance of energy security and efficiency of EU member countries (Patlitzianas et al., 2007; Luiten, 1999 quoted after Naimi et al., 2012, p.353). The roots of the DPSIR framework can be traced back to the Stress–Response framework developed by Statistics Canada in the late 1970s (Rapport and Friend, 1979). In the 1990s, this approach saw further development by, among others, the OECD (1991, 1993) and the United Nations (1996, 1999, and 2001). The DPSIR framework was first elaborated in its present form in two studies by the European Environmental Agency (EEA, 1995; Holten- Andersen et al., 1995 2003 quoted after Svarstad et al., 2007, p.2).

Figure 6.4: DPSIR framework



Source: Jago-on et al., 2009 quoted after Naimi et al., 2012, p.354

Smeets and Westerings provide a 'systems analysis' view of DPSIR and describe it as follows: ''According to this systems analysis view, social and economic developments exert Pressure on the environment and, as a consequence, the State of the environment changes, such as the provision of adequate conditions for health, resources availability and biodiversity. Finally, this leads to Impacts on human health, ecosystems and materials that may elicit a societal Response that feeds back on the Driving forces, or on the state or impacts directly, through adaptation or curative action'' (Smeets and Weterings, 1999, p. 6).

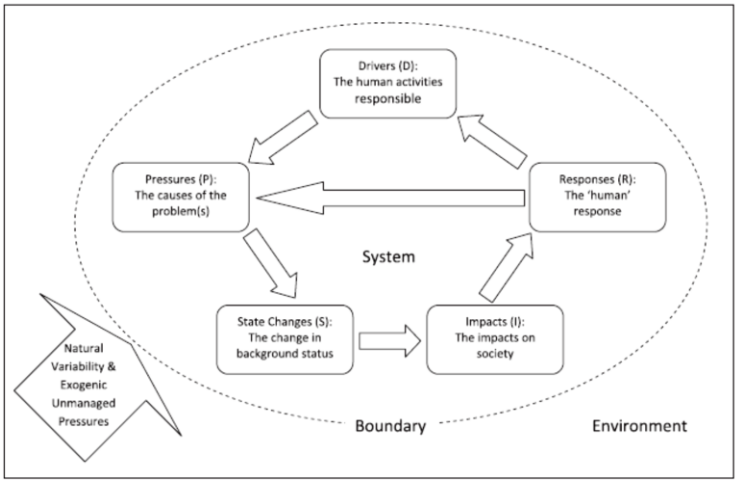
As shown in figure 6.4, Drivers which may be social, economic or environmental developments exert Pressures on a certain environment. As a result of these Pressures, the State of the environment changes. This then leads to an Impact (social, economic or environmental), which may lead to a societal Response. The response may feed back to Drivers, Pressures, States or Impacts (Smeets and Weterings, 1999, p. 8).

The DPSIR framework embodies a systems perspective, implying the demarcation of a particular system of interest, with explicit or implicit boundaries. The system is bounded in two ways. Firstly, it is bounded in terms of the scale at which the Impacts are defined, e.g. a single river up to the entire world. Secondly, it is bounded in terms of the scale of the Responses and Driving forces affecting this system, e.g. local economic changes up to global environmental agreements. The boundaries will not necessarily coincide; Impacts at one scale will often be determined by Responses and Driving forces that act at a different scale. The drawing of these boundaries depends on the particular issue of interest and its conceptualization, which are strongly influenced by the perspective of those using the framework (Svarstad et al., 2007, p.2).

Figure 6.5 is an illustration for DPSIR by Berger and Hodge including feedback loops between Responses and Drivers and Pressures, and it also recognizes that there are natural pressures (based on ecology, climate, and other dynamic conditions) on the ecosystem which can lead to State Changes (Berger and Hodge, 1998 quoted after Gregory et al. 2013, p.560). Pressures on the system can be locally/ regionally/ internationally endogenic managed pressures (such as power generation, and fisheries) or exogenic unmanaged pressures (such as

climate change, and volcanic eruptions) (Gregory et al. 2013, p.560). Some researchers consider DPSIR as a policy making perspective or framework, others as a sustainable development methodology, some (Gregory et al., 2013) as a decision supporting system and as a Problem Structuring Method (PSM).

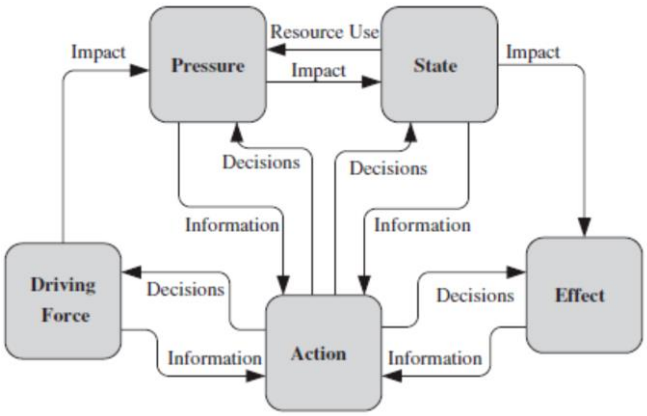
Figure 6.5: A generic DPSIR model



Source: Berger and Hodge, 1998 quoted after Gregory et al. 2013, p.560

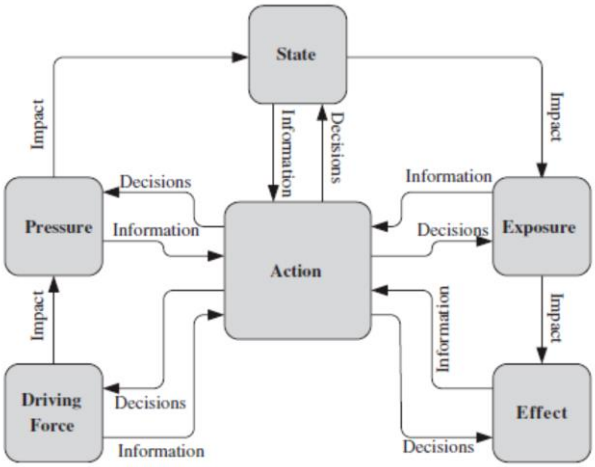
DPSEA and DPSEEA have been developed by the World Health Organization (WHO) to model the linkages between environment and human health (Kjellstrom and Corvalan, 1995 quoted after Naimi et al., 2012, p.354). The negative impacts of development pollution on the local scale, acid rain on the regional one and ozone depletion on the global one should have been considered in decision making procedures. So, in 1987, the World Commission on Environment and Development (WCED) called the international organizations so that these could be taken into account (Mikkelsen, 2002 quoted after Naimi et al., 2012, p.354). Rio Declaration (Agenda 21) sustainable development emphasized the above mentioned conflicts and stated that ‘‘Human beings are at the center of concerns for and entitled to a healthy and productive life in harmony with nature’’. Considering Rio Declaration, the WHO, focused on the critical relationship between environment and human health, in the document ‘‘Our Planet, Our Health in 1993’’. It explains that a wide range of new hazards including traditional and modern ones associated with new technologies and unsustainable developments threaten the human health.

Figure 6.6: DPSEA framework



Source: Spiegel et al., 1997 modified by Naimi et al., 2012, p.354

Figure 6.7: DPSEEA framework

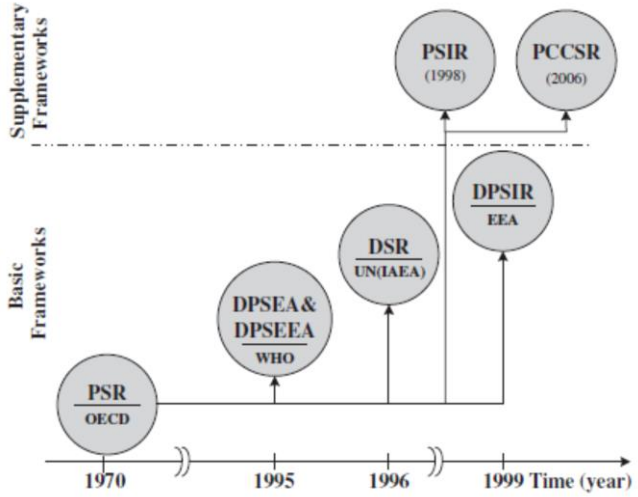


Source: Khan et al. modified by Naimi et al., 2012, p.355

The DPSEA framework is composed of five components including Driving Force, Pressure, State, Effect and Action as illustrated in figure 6.6 (Kjellstrom and Corvalan, 1995 quoted after Naimi et al., 2012, p.354). In the first level, Driving Forces create Pressures on the environment which alters the State of the environment by increasing existing and new Exposures and produce a measurable health Effect. Driving Forces including economic and technology developments, consumption patterns and population growth cause the environmental health hazards to appear. The Driving Forces generate different kinds of Pressures on the environment, in such forms as waste and depletion of natural resources or emission of pollutants from energy production, manufacturing, transport, etc. These Pressures change the State of environment such as deforestation, concentration of chemicals in air, soil, water and soon. Becoming exposed to these altered States of environment can lead to a wide range of health Effects depending on the type of hazards and the level of exposures (Corvalan et al., 1999 quoted after Naimi et al., 2012, p.355). As a result, action must be taken to fix the problems. Based on DPSEA framework, a new framework as DPSEEA has been developed, as seen in figure 6.7 (Khan et al., 2007 quoted after Naimi et al., 2012, p.353).

In addition to the above mentioned basic frameworks, other supplementary frameworks, like Pressure–State–Impact–Response (PSIR) and Pressure–Carrying Capacity–State–Response (PCCSR) have also been proposed (Lockie and Rockloff, 2005; Guoetal.,2006 quoted after Naimi et al., 2012, p.355). All the basic and supplementary frameworks originate from PSR with some modification as seen in figure 6.8. Another important point seen in the figure is that all the frameworks are developed by international organizations such as OECD, WHO, UN/IAEA and EEA/ Eurostat. Moreover, according to national situations of the world countries, many sets of SDIs have been developed by different countries based on these frameworks (IAEA et al., 2005; Patlitzianas et al., 2007; Asia Pacific Energy Research Center, 2000 quoted after Naimi et al., 2012, p.355).

Figure 6.8: Evolution of policy making frameworks



Naimi and Vaez-Zadeh, 2012, p.355

6.1.2 Benefits of causal chain frameworks/ DPSIR

The use of conceptual frameworks based on causality has important benefits. Such frameworks, using a clearly structured organization of the indicators enable a clear and concise communication to decision-makers. They help to expose how the information provided by the indicators is related to various processes and how specific policy or management actions can address human-induced environmental problems. Additionally, a uniform approach to indicator reporting helps to link up different but related assessment areas (e.g. transport and environment, agriculture and environment) (Niemeijer and Groot, 2008, P.90).

“A presumed strength of the DPSIR framework is that it captures, in a simple manner, the key relationships between factors in society and the environment, and, therefore, can be used as a communication tool between

researchers from different disciplines as well as between researchers, on the one hand, and policy makers and stakeholders on the other" (Berger and Hodge, 1998; Rapport et al., 1998; Rekolainen et al., 2003 quoted after Svarstad et al., 2007, p.1).

Recently, DPSIR has been used for an interdisciplinary indicator development, model conceptualization and the structuring of policy relevant research (Svarstad et al., 2008). Lundberg (2005) notes further that the DPSIR framework is an example of the integration of knowledge from several disciplines, and it is a way of explaining cause–effect relationships between the environment and socio-economic factors (Tscherning at al., 2012, p.103).

Tscherning et al. (2012) state that through the participative integration of politicians, environmental managers, experts from other disciplines, journalists, and the general public the "real world" knowledge has been integrated into conceptual models, and the multiple cause–effect relationships have been adopted in many studies. They conclude that the DPSIR framework offers the chance to link scientific findings with "real world" issues and, therefore, may serve as a means of bridging the gap between research and decision making. They state that the application of DPSIR may allow policy relevant research because it supports the explanation and communication of research results to decision makers in an accessible and meaningful way. It further leads to the presentation of stakeholder values and alternative decision options, rather than to rigid and predetermined solutions.

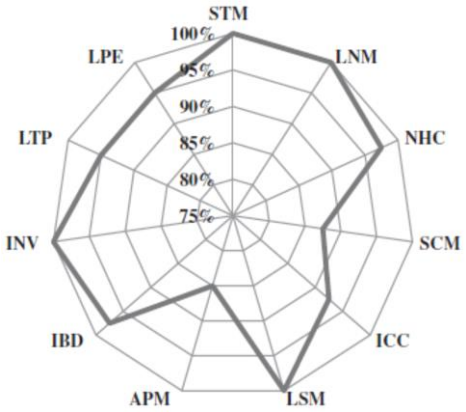
6.1.3 Shortcomings of causality-issue frameworks

Niemeijer and Groot (2008, p.95) believe that the causality-issue matrix approach is not very conducive to understanding the dose– response functions because (1) it presents much simplified relations that omit complicating external factors and many of the intermediate steps, and (2) it does not account for the fact that we are seldom dealing with one-to-one relations between pressure and state indicators, let alone between state and impact indicators." They believe to achieve a truly integrated environmental assessment and that we still need adequate insight into the inter-relation of indicators—the webs of causes and effects—even if we are not seeking quantitative dose–response functions and try to recommend an enhanced DPSIR framework as a casual network rather than a casual chain their research in 2008. The main difference is that the causal network approach considers all the inter-relations between indicators and not just those along a single causal chain pathway and is more a appropriate concept to deal effectively with the complexity of real world interactions. After the implementation of such concept Niemeijer and Groot state that it helps identifying key components, the key nodes in the network. It can contribute to selecting consistent indicator sets and provides a way to identify ''control points'' for the monitoring and management of sustainability. Finally, it can be the first step towards establishing dose–response functions.

"Partly due to its simplicity the DPSIR framework has been criticized as well. It has been argued that the framework cannot take into account the dynamics of the system it models, cannot handle cause–consequence relationships, suggests linear unidirectional causal chains, and ignores key non-human drivers of environmental change" (Berger and Hodge, 1998; Rapport et al., 1998; Rekolainen et al., 2003 quoted after Svarstad et al., 2007, p.1). Meyar- Naimi and Vaez-Zadeh list several critical points about the frameworks and their applications as followed:

1. Single Trajectory Modeling (STM)
2. Linear Modeling (LNM)
3. Neglecting Historical Constrains (NHC)
4. Static Modeling (SCM)
5. Ignoring Carrying Capacity Constraints (ICC)
6. Lack of Social Modeling (LSM)
7. Assessment Instead of Policy Making (APM)
8. Ignoring the Balance of Dimensions (IBD)
9. Ignoring National Visions (INV)
10. Lack of Time scale Policies (LTP)
11. Lack of Policy Evaluation (LPE)

Figure 6.9: Shortcomings sun rays curve of the frameworks



Naimi and Vaez-Zadeh, 2012, p.359

Summary of the aforementioned discussion is depicted by a sun ray curve in figure 6.9. Considering more than 40 reviewed papers, it can be seen that 97.5, 87.5, 92.5, 85, 97.5, 95 and 95% of all applications suffer from deficiencies of NHC, SCM, ICC, APM, IBD, LTP and LPE , respectively. But shortcomings of STM, LNM, LSM and INV are seen in all of them.

In the following research it will be attempted to enter socio- economic and cultural drivers to the model and consider the urban issue as a comprehensive and multi-dimensional problem. This is exactly what many of researchers have emphasized as a key solution to improve DPSIR model. For example, Svarstad believes that this method needs to be more comprehensive and therefore a modification is necessary. He states: " We do not argue that the DPSIR framework necessarily should be rejected, however. Rather, we call for further research to explore the potentials for expanding the DPSIR framework, and its application, so as to incorporate the mentioned social and economic concerns. This implies bringing adequate attention not only to the state of the environment, but also to the state of social matters. The understanding of socio-economic and cultural drivers should be broadened, and it is pivotal to properly analyze social, economic and cultural conflicts that surround the issue in focus. Thus, there is a particular need for elaboration of methodology to address attitudes and definitions of the problem held by stakeholders and the general public'' (Svarstad et al., 2008, p. 123).

Svarstad (2002, 2004) and Adger et al (2001) also presented four biodiversity discourse types and then later Svarstad et al. in 2008 examined and explored how the application of the DPSIR framework appear through the lenses of these discourse types: Preservationist, Win–win, Traditionalist and Promethean. Based upon this examination, he and his team argued that the DPSIR framework is not a tool generating neutral knowledge. Instead, applying this framework reproduces the discursive positions the applicant brings into it.

"The Preservationist discourse type concentrates entirely on the aim of conserving species, biotopes and landscapes. There is little concern for the restrictions that these interventions place on local resource users. This discourse type reflects views held by many of the early preservationists in the late 19th and early 20th centuries who raised concerns for nature protection. Whereas preservation is perceived here as an advantage for humanity due to the value of nature in itself, negative impacts on human beings including those that can be measured as economic costs, are largely ignored" (cf. Waetzold and Schwerdtner, 2005 quoted after Svarstad et al., 2008, p.4).

"In the Preservationist discourse type, the central concern is the State of biodiversity. Impacts are understood as effects on nature, and the key concerns are the reduction and loss of habitats and species. Economic costs and other negative impacts on human beings arising from preservation are largely ignored. Responses focus on strictly enforced protection of habitats and species. These are seen as necessary to change the perceived Pressures from human activities, such as urban expansion, infrastructure developments, and economic activities such as logging and other extraction of natural materials. In terms of Driving forces behind this development, the emphasis tends to be put on population growth and economic growth. Overall, the DPSIR framework, as traditionally applied, is well suited to examine all aspects of a Preservationist concern.

Turning to the Win–win discourse type, the State of biodiversity remains in focus as is the case of the Preservationist discourse type. Both these discourse types also have in common a prior concern for direct Impacts on nature. However, the Win–win type provides additional concern for social impacts of biodiversity losses. These include the potential losses of future medicines, recreational opportunities, stable and clean water supplies, and economic development from tourism. In relation to developing countries in particular, there are claims that conservation and development can not only create win–win links, but also that the neglect of social needs leads to situations where poor people cause serious degradation of the environment. This is possible to deal with through the DPSIR framework, but in its traditional application, impacts regarding the environment are those emphasized. Moving on to Responses, they found that the Win–win discourse type often includes protective efforts more or less identical to those suggested in protectionist discourses. However, due to the weight in this discourse type on social impacts along with direct environmental impacts, the Response category also has to involve relevant responses to the emphasized social impacts. These responses may consist of, for instance, compensation payments for conservation measures, or they may involve limited and regulated

utilization of local resources. The DPSIR framework provides the main focus upon responses to environmental impacts, but it is not impossible to apply it also about responses to social impacts." (Svarstad et al., 2008, p.6). In addition Svarstad, Adger and others' analysis has shown that the Preservationist discourse type is totally compatible with the DPSIR framework as traditionally applied. Furthermore, they found that the DPSIR framework makes it possible to take into consideration main concerns of the Win–win discourse type. Nevertheless, social aspects do not constitute well-elaborated dimensions of the framework, and social concerns of this discourse type may therefore be ignored. Moreover, they found that adequate representation of the Traditionalist or the Promethean discourse type would require a fundamental shift in the application of the DPSIR framework. Although both of these discourse types focus on biodiversity and are often present among actors in conflicts over biodiversity, the structural design of the DPSIR framework as traditionally used is not able to incorporate views of these types (Svarstad et al., 2008, p.8).

Svarstad et al. found that when applied in its traditional form to studies in the field of biodiversity, the framework is most compatible with the Preservationist discourse type and tends to favor conservationist and to neglect other positions. (Svarstad et al., 2008, p.1).The described research is convincing enough for utilizing DPSIR model in this research with a Preservation content. It will be attempted to use the combination of Preservationist and a Win-win discourse as the driving forces in both emphasize on population growth, economic growth and uneven social distribution. The approach is not limited to preservationist because the pure natural point of view will weaken the multidimensional character of the research. By Win- Win discourse there is an extra attention to well-being and socioeconomic factors. Figure 6.10 describes these four discourses in the framework of DPSIR framework.

Figure 6.10: Exploration of the Application of DPSIR framework to biodiversity discourse types

	Preservationist	**Win-win**	**Traditionalist**	**Promethean**
State (S)	State of biodiversity as the concern.	State of biodiversity as primary concern.	State of social matters as central concern (beyond DPSIR's S).	State of biodiversity not significant (beyond DPSIR's S).
Impacts (I)	Effects on nature alone.	Primary concern for impacts on nature. Also a focus on social impacts of biodiversity losses (unusual but possible focus with DPSIR).	Impacts on local people (beyond DPSIR's I).	Impacts on biodiversity not significant (beyond DPSIR's I).
Responses (R)	Protection of habitats and species.	Protection of habitats and species. Also responses to social impacts of biodiversity losses (unusual but possible focus with DPSIR).	Promoting local win-win solutions.	Rejection of conservation (beyond DPSIR's R)
Driving Forces (DF)	Emphasis on population growth and economic growth.	Emphasis on population growth and economic growth. Also concern for uneven social distribution.	No focus on DF regarding biodiversity losses, but DFs from Preservationist and Win-win approaches (beyond DPSIR's DF).	No focus on DF regarding biodiversity losses, but DFs from Preservationists and Win-win approaches, and with conservation as sole problem maker (beyond DPSIR's DF)
Pressures (P)	Human activities such as urban expansion, economic activities, etc.	Poverty, diminishing biodiversity and thus well-being.	No focus on P regarding biodiversity losses, but on threats from external actors, e.g. economic interests and conservationists (beyond DPSIR's P).	No focus on P regarding biodiversity losses, but on threats from conservationists (beyond DPSIR's P).

Source: Svarstad et al., 2008, p. 7

6.1.4 Applications of different policy making frameworks

"PSR has been used mainly for sustainability assessment of environment. In this regard, one of its most widely used applications is the evaluation of ecological security. Based on the PSR framework and using the fuzzy optimization and AHP methods, an ecological security pre-warning model is constructed for assessing a province and an agricultural ecosystem in a county as depicted in figure 6.11" (Kai-ya et al., 2005; Zhu et al., 2009 quoted after Meyar- Naimi et al., 2012, p.352). Using the PSR framework, a model is extended to assess the coastal systems off our countries and two agricultural areas of China from sustainable development point of view" (Ferreira et al., 2007; Zhen etal.,2009 quoted after Meyar- Naimi et al., 2012, p.352). "PSR frame-work is used to measure change of land cover, landscape features, freshwaters, habitats and the vegetation of Britain (Firbank et al., 2003). Using PSR framework and AHP and Analytical Network Process (ANP) methodologies, forest management strategies are planned and their sustainability are assessed" (Xiaodan et al., 2010; Wolfslehner and Vacik, 2008 quoted after Meyar- Naimi et al., 2012, p.352).

Figure 6.11: PSR framework for assessment of ecological security

Pressure	State	Response
Population	Landscape vulnerability	Reduce influences
Social	Landscape stability	Improve states
Economy	Landscape integrity	

Source: Zhu et al., 2009 quoted after Naimi et al., 2012, p.352

"Since the initiation of the DSR framework some applications have been reported. Considering human activities and natural resources within DSR framework, a system dynamic model is proposed for sustainable land use management in a river basin, as shown in figure 6.12. Further, using the DSR based indicators; a budget allocation system is developed to achieve environmental sustainability and making appropriate budget allocations for regional water quality management and developing a sustainable river basin land use management decision support system" (Kao et al., 2009; Chen et al., 2005).

Figure 6.12: DSR frame work for sustainable land use management

Driving force	State	Response
Energy	Water quality	Land use plan
Transport	Water quantity	Water supply plan
Industry	Land area	River water quality standard
Agriculture	Land use type	Waste water treatment
Commercial	Air quality	Air quality standards
Residential		Air pollution control plan
Forestry		

Source: Zhu et al., 2003 quoted after Naimi et al., 2012, p.353

"The DPSIR framework, along with its earlier incarnations, is a widely accepted and commonly used framework for interdisciplinary indicator development, system and model conceptualization, and the structuring of integrated research programs and assessments." (for example, EEA, 2005, OECD, 2003; UNEP, 2002; Walmsley, 2002 quoted after Svarstad et al., 2007, p.1)

Naimi and Vaez- Zadeh in 2012 have reviewed a vast range of DPSIR applications in different fields as followed: "DPSIR framework has been used extensively for environmental issues e.g. sustainability assessment of subsurface groundwater protection. DPSIR is applied to assess the pressures from agricultural landuse on surface and groundwater and to develop the Sustainable Development Indicators for managing bio-solids in Ireland (Giupponi and Vladimirova, 2006; Amajirionwu et al., 2003).Further, DPSIR is used to review environmental impact associated with CO2 capture from power plants, transport by pipeline and storage in geological formations (Koornneef et al., 2011). Furthermore, DPSIR framework is used within the methods of

system thinking and system dynamics to generate and assess the strategic environmental policies (Chen et al., 2011). In addition, a methodology is proposed for assessing the environmental impacts of EU common agricultural policy and the pesticide reduction program in Flanders and Belgium (Zalidis et al., 2004; Smet etal., 2005). Applying the conceptual DPSIR framework the impact of urban sprawl on water balance in a city of Germany and the nitrogen pressure from agriculture on water resources at European level are assessed (Hasse and Nuissl, 2007; Fassio et al., 2005). DPSIR framework is also enhanced as DPCER to fit better the European water framework directive implementation process (Rekolainen et al., 2003).

Tscherning et al. (2012) list the applications of DPSIR in research and different fields of study as followed: "After its adoption by the EEA in 1995, DPSIR became popular in studies involving the management of nutrient fluxes in marine environments (Turner et al., 1996; Newton et al., 2003; Scheren et al., 2004), integrated coastal management (Bowen and Riley, 2003), development in catchment areas (Cave et al., 2003), and offshore wind power generation (Elliot, 2002). The framework has been applied worldwide, ranging from global (Odermatt, 2004) to national scales. Additionally, some studies have been carried out on a catchment scale (Karageorgis et al., 2005; Pirrone et al., 2005) or on a regional scale (Holman et al., 2005). DPSIR has been used for parallel assessments dealing with environmental and socioeconomic perspectives and impacts (Odermatt, 2004; Agyemang et al., 2007; Mangi et al., 2007; Giupponi et al., 2006). In addition, an increase in research on sustainable development broadened the use of DPSIR because it enables integrative, multidimensional assessments (Pintér et al., 2005). A number of DPSIR studies have dealt with the agricultural sector and rural areas (e.g., Odermatt, 2004; Pirrone et al., 2005; Borja et al., 2006). DPSIR is described as a reliable scientific tool for tackling environmental issues (Karageorgis et al., 2005) and as a starting point for both scenario analysis (Pirrone et al., 2005) and participatory scenario analysis (Ledoux et al., 2005). Recent studies have indicated that stakeholder values are the key to structured policy making with public involvement (Lorenzoni et al., 2000; Gregory et al., 2001). Agyemang et al. (2007) used DPSIR successfully in Ghana to organize complex environmental information and present it to policy makers. The authors reported that despite its use in Europe, DPSIR is not well known in developing countries. Nilsson et al. (2009) used the DPSIR as a basis for a framework to follow-up Strategic Environmental Assessment (SEA). SEA runs in parallel with the decision making process and assesses policies in respect to their impacts on the environment or on Sustainable Development."

The DPSEA framework is used to illustrate the inter-relations of environment, development and human health, to discuss the environmental contaminant, workplace safety and health hazards and to assess the drinking water quality in New Zealand (Spiegel and Yassi, 1997; Mikkelsen, 2002; Khan et al., 2007 quoted after Naimi et al., 2012, p.353). According to DPSEEA, a systematic analysis of road transport systems is presented with different types of health effects and Exposures such as radiation, toxic chemicals and noise as shown in figure 6.13 (Kjellstrom et al., 2003 quoted after Naimi et al., 2012, p.353). The EU and WHO used the DPSEEA framework to monitor the causal chain of road accident health effects (Farchi et al., 2006 quoted after Naimi et al., 2012, p.353).

Figure 6.13: DPSEEA applied to transport policy and health

Driving force	Pressure	State	Exposure	Effect
Car transport	Increasing car density	Conflicts between cars and pedestrians	Time spend in hazardous situations	Motor vehicle crash injuries
	Emission of air pollutants	Air concentration of lead, nitrogen oxides, carbon monoxide and particles	Personal exposure estimate	Effect on heart and respiratory systems
	Noise emission from roads	Noise levels in community	Time spent in noisy environment	Noise disturbance on sleep and study
	Percentage daily commuting by car	Average daily physical activity	Daily individual active transport energy expenditure	Obesity and associated heart disease or diabetes

Source: Kjellstrom et al., 2003 modified by Naimi et al., 2012, p.355

6.1.5 Application intensity and area of the frameworks

A survey of 40 case studies done by Naimi and Vaez-Zadeh in 2012 regarding the reviewed frameworks reported during 1994–2011 is provided to compare application intensities and application areas as shown in figure 6.14 and 6.15. The application intensities of DPSIR and PSR frameworks have increased during 1995–2011, in contrast with the application intensities of DSR, and DPSEA & DPSEEA ones. This is probably due to their temporal precedence and complexity. It is known that PSR is the simplest framework, which needs less information than DPSIR. However, DPSIR breaks a problem to more components and so needs more information and provides more accurate and detailed results. As shown in figure 6.14 Naimi and Vaez-Zadeh (2012, p.355) found that out of 40 applications of frameworks in this period of time, 15 have used PSR, 13 DPSIR, 6 DSR and just 5 DPSEEA. Figure 6.15 shows that environmental (ENV) and energy sectors have the highest shares in the application areas of policy making frameworks. This is due to an increasing attention to environmental protection and energy sustainability since 1995.

Figure 6.14: Application intensity of the frameworks

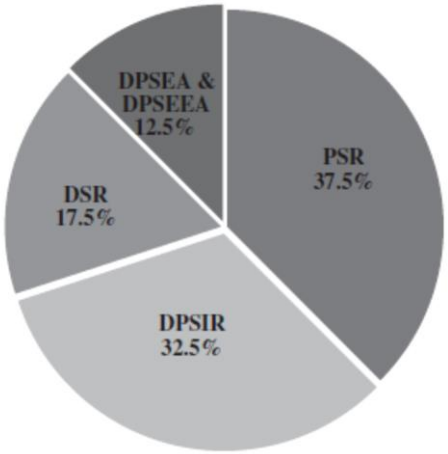
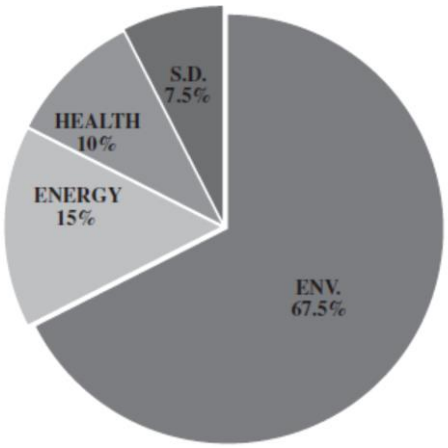


Figure 6.15: Application area of the frameworks



Source: Naimi and Vaez- Zadeh, 2012, p.356

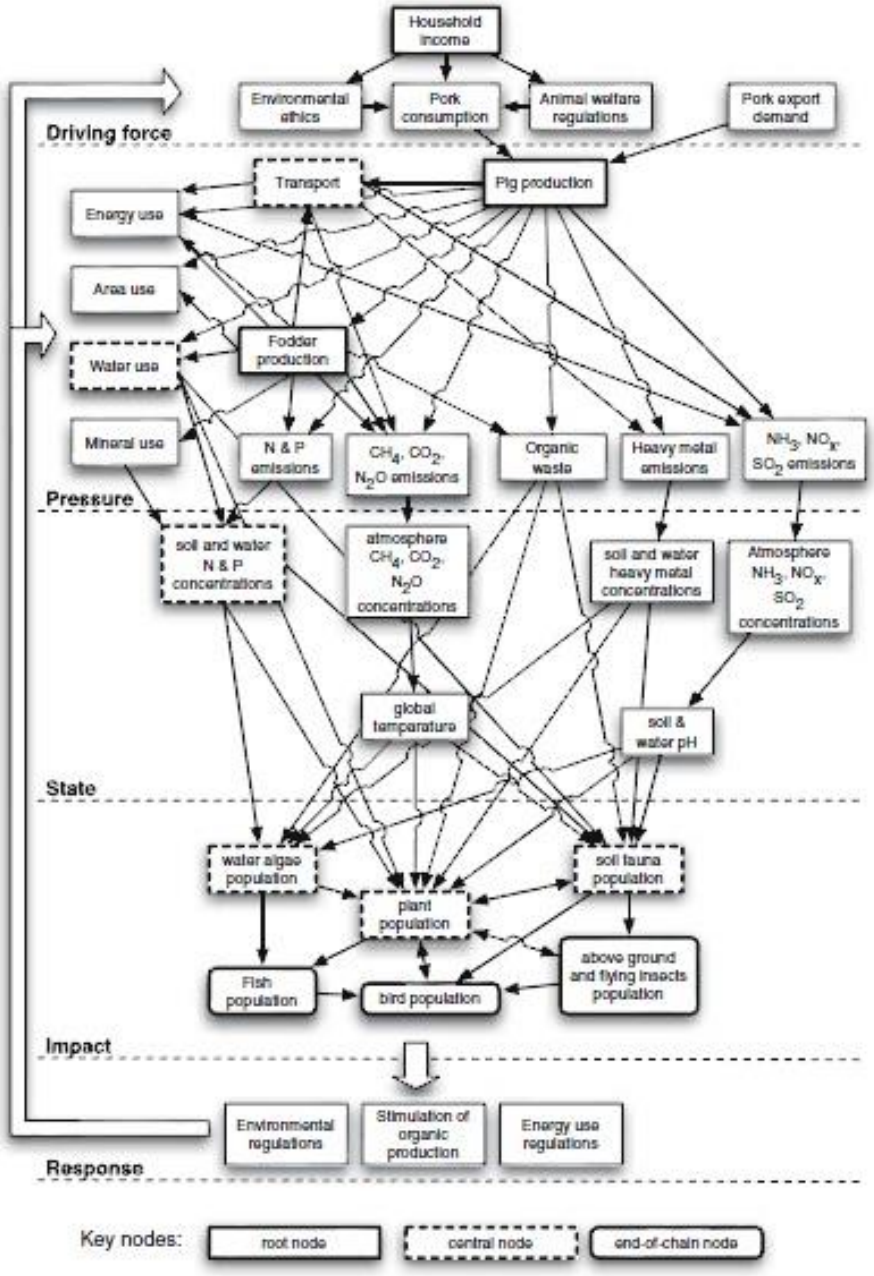
Tscherning et al. (2012) "assessed 21 studies that were reported between 2003 and 2009 that used DPSIR and were published in peer reviewed journals and books. They used the analysis and methods included in the 21 studies to check for trends over time. The 21 studies published between 2003 and 2009 reflected diverse uses of DPSIR. Six of the 21 studies applied DPSIR in relation to participatory research and scenario development, and five studies used it to structure modeling exercises. Furthermore, DPSIR was applied in three cases for indicator framework description. It was used in Europe, Sub-Saharan Africa, Asia and Latin America or at a global level. A slight temporal trend was observed; indicating that while in earlier studies (2003–2006) DPSIR was predominantly used for water management purposes (at watershed, coastline, sea and estuarine levels), the focus changed to land degradation, farming systems, climate change and biodiversity from 2007 onwards. This determined the choice of journals in which the studies were published."

6.1.6 Overcoming the shortcomings of DPSIR

Meyar-Naimi and Vaez-Zadeh in 2012 believe that "the shortcomings of the frameworks commonly used in the SD policy making especially in the field of energy, new energy policy making frameworks should take into account complex, multi trajectory, non-linear and dynamic interrelations of energy system components and carrying capacity limits of the indicators. Also, energy policy frameworks are required to consider the overall national visions as an input to their policy making procedures. Thirdly, they should improve the balance of the energy system dimensions. Finally, the effects of new policies on the energy systems should be estimated before a final policy decision is made."

Niemeijer and Groot state that the causality-issue matrix approach is not very conducive to understand the dose–response functions for two mentioned reasons. They then suggest that a causal network, rather than a causal chain, is a more appropriate concept to effectively deal with the complexity of real world interactions. To think of the inter-relations between indicators in terms of a network not only makes more sense conceptually, but may even open the door to applications relying on the mathematical theories related to causal networks. (Niemeijer and Groot, 2008, p.95, 100) Figure 6.16 shows a proposed network by Niemeijer and Groot. "When looking at an indicator causal network there are two important elements we can distinguish, the ''pressure interface'' and the various ''key nodes''. With the term pressure interface we are referring to the economic sector or human activity that exerts a pressure on the environment. In the case of our example, pig production may be considered the pressure interface where society exerts pressure through its use of natural resources and through the emissions of all kinds of substances to the environment. Recognizing the pressure interface is important because it is the funnel through which a whole range of driving forces exerts pressures on the environment. It is at the pressure interface that the translation takes place from driving forces to pressures and therefore the place where through management we can influence the degree and way in which driving forces lead to environmental problems.

Figure 6.16: A simplified causal network centered on pork production



Source: Niemeijer and Groot, 2008, p.103

The other important element is, what can be called ‘‘key nodes’’. These are nodes in the causal network that have a higher than average number of incoming or outgoing arcs or both. There are basically three types of key nodes: root nodes, central nodes and end-of-chain nodes. Root nodes are those notes that have many outgoing arcs (the arcs diverge from these nodes). They are typically the source of many environmental problems. Central nodes are those nodes that have many incoming and/or outgoing arcs (converging and diverging arcs). They typically play an important role in the web of causes and effects. End-of-chain nodes typically have multiple incoming arcs (the arcs converge at these nodes) that bring together a number of longer chains. These nodes are typically those nodes where the (often indirect) effects of multiple pressures become visible. Using the key nodes it is possible to identify different categories of indicators that each has a specific kind of utility. Indicators associated with root nodes are important because they provide information on the source of multiple issues or environmental problems. Indicators associated with central and end-of-chain nodes are important because they will allow us to gauge the impact of multiple processes or issues at once. Indicators associated with key nodes with a large number of connecting arcs will typically be the most generally useful indicators since they are likely to have a bearing on a large number of issues and research questions.

In sum, the enhanced DPSIR framework, which is based on causal networks rather than causal chains, has multiple benefits. It gives more insight into the complexity of cause–effect relations, including cross-theme and cross- sectoral issues. It helps identifying key components, the key nodes in the network. It can contribute to selecting consistent indicator sets. It provides a way to identify ‘‘control points’’ for monitoring and management of sustainability. Finally, it can be a first step towards establishing dose–response functions. (Niemeijer and Groot, 2008, p.95, 101-104)

6.2 Conclusions: the suitability of DPSIR in the research

The collected data in the first chapters have been analyzed and the derived criteria have been categorized. In this part the whole outcomes of the first five chapters have to be first summarized and then organized and classified to make a better understanding of the entire research process and its goals. The topics and discussions in different parts have to be coordinated under a unique model to perceive an image of how the research is developing and if all the aspects of the multidimensional issue in Tehran have been taken in to consideration. Studying the characteristics and applications of DPSIR inspired the author that it can be a suitable framework for analytical model. It summarizes the data in each phase and describes the process, reasons and effective indicators.

As reviewed above, Meyar-Naimi and Vaez-Zedeh consider DPSIR as a *policy making framework*. In 2012 they admitted what Nathan and Reddy in 2008 have stated; they all consider DPSIR as a *Sustainable Development policy making framework*. The theoretical basis of this research is based on Sustainable development dimensions in different urban aspects and the final outcomes will be policy making as the title implies. Therefore the combination of these two facts can be the very first reasons why DPSIR is suitable for the content of this research. On the other hand, Gregory et al. (2013) call this framework a *decision support system* and this system is exactly what is required in this chapter to move on to the final decisions and policy makings.

Berger and Hodge (1998), Rapport et al. (1998) and Rekolainen et al. (2003) say that DPSIR captures the key relationships between factors in society and the environment, and, therefore, can be used as a communication tool between researchers from different disciplines and policy makers and stakeholders on the other. This fact is what this research is pursuing; trying to find a connection/balance between society and environment on one side and consequently researchers and policy makers on the other side. Tscherrning et al in 2012 also express the same point of view that DPSIR is a link between scientific findings and real world issues. As a result it bridges the gap between research and decision making.

Further Svarstad et al. (2008) confirm that recently DPSIR has been used for inter-disciplinary indicator development, model conceptualization and the structuring of policy relevant. Lundberg (2005) furthermore noted that the DPSIR framework is an example of the integration of knowledge from several disciplines. As explained before the multidimensional character of the research depends upon inter-disciplinary concept that it follows.

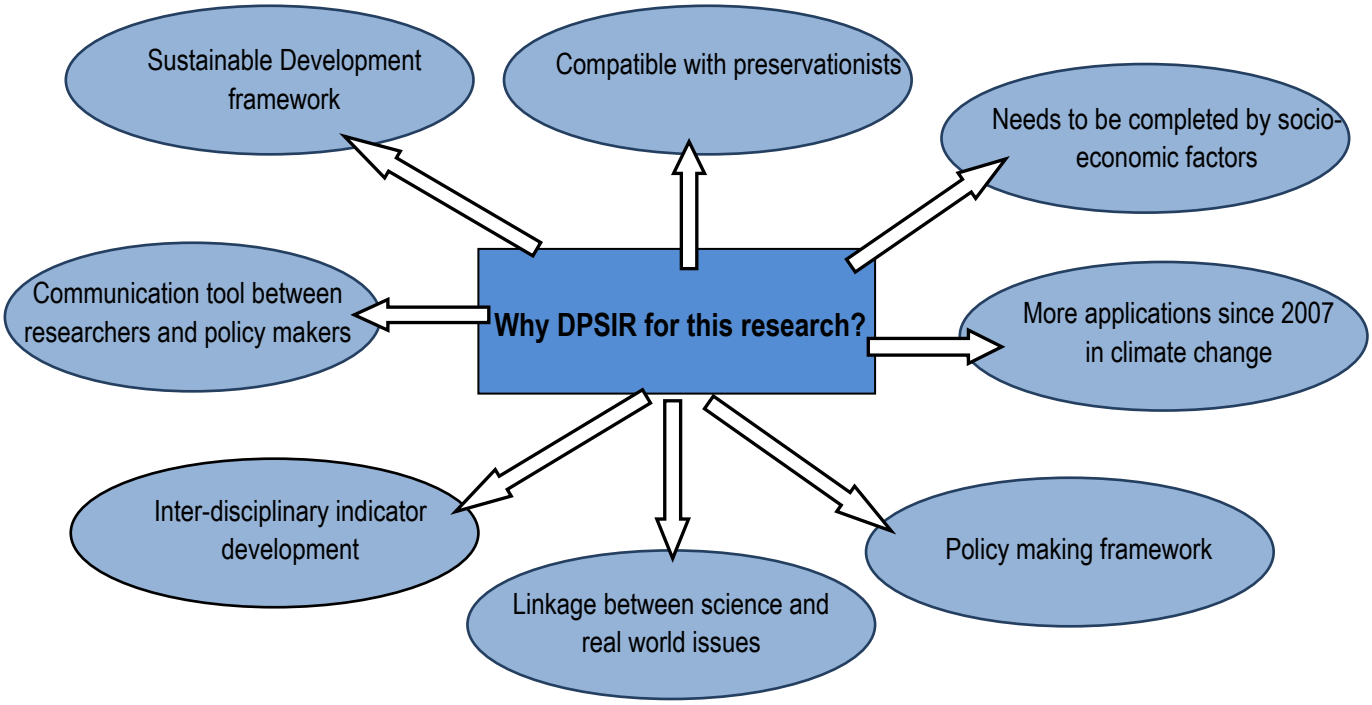
Subsequently it expands its boundaries in different fields of economy, sociology, ecology, finance, cultural science and urbanism. Recurrently DPSIR adjusts the research framework according to literature review and can also highlight one of the main qualifications of the study. In addition, more applications of this method in domain of climate change and land degradation since 2007 reported by Tscherning et al. in 2012 strengthens the idea of utilizing the framework for the research with the same content.

Moreover Svarstadt et al. (2008) bring up a topic by exploring how the application of this framework spears through lenses of biodiversity discourse types. They conclude that Preservationist discourse which has landscape conservation as one of its approaches is the most compatible path with DPSIR and this encourages once again the application of this model in this research. Note that preservationist will not be the only approach of the research as it leads to pure environmental study. To add more socio- economic character to the work and make it more multidimensional win- win discourse will be pursued in a way.

The last but not the least reason of suitability of DPSIR for the research is the statement of Svarstad et al. in 2006 about developing countries; they claim that conservation and development can not only create win–win links, but also that the neglect of social needs in these countries causes serious degradation of the environment. This is possible to deal with through the DPSIR framework and this is one of the problems discussed in Tehran in the previous chapters.

All in all the above mentioned facts and reasons as illustrated in figure 6.17 prove that DPSIR can be a good model for the analytical model of the study and helps the author approach her goals easier.

Figure 6.17: The reasons of utilizing DPSIR framework as an analytical model of the research



Source: The author

6.3 Theoretical framework and analytical model

The outcomes of the research procedure will be summarized as an analytical model which is an image for theoretical framework. The theoretical base of the research is also based on this model. The research review in the first chapter can be summarized as figure 6.18. The figure apparently describes how the research has developed from a main problem, the questions based on the problem, goals and consequently objectives set to

solve the problem and answer to the research questions and the hypotheses which have to be examined during the research process. The main problem is green lands' destruction in Tehran which has a negative influence on urban image and human life. This problem raises questions like if there are different criteria in different fields which have impact on green lands' sustainability and if an urban management structure with the means of incentive plans can set policies to prohibit these criteria in Tehran. Therefore the main goal will be multidimensional policies and programs to preserve gardens and agricultural lands.

Figure 6.18: Research elements in one view and the implicit DPSIR model

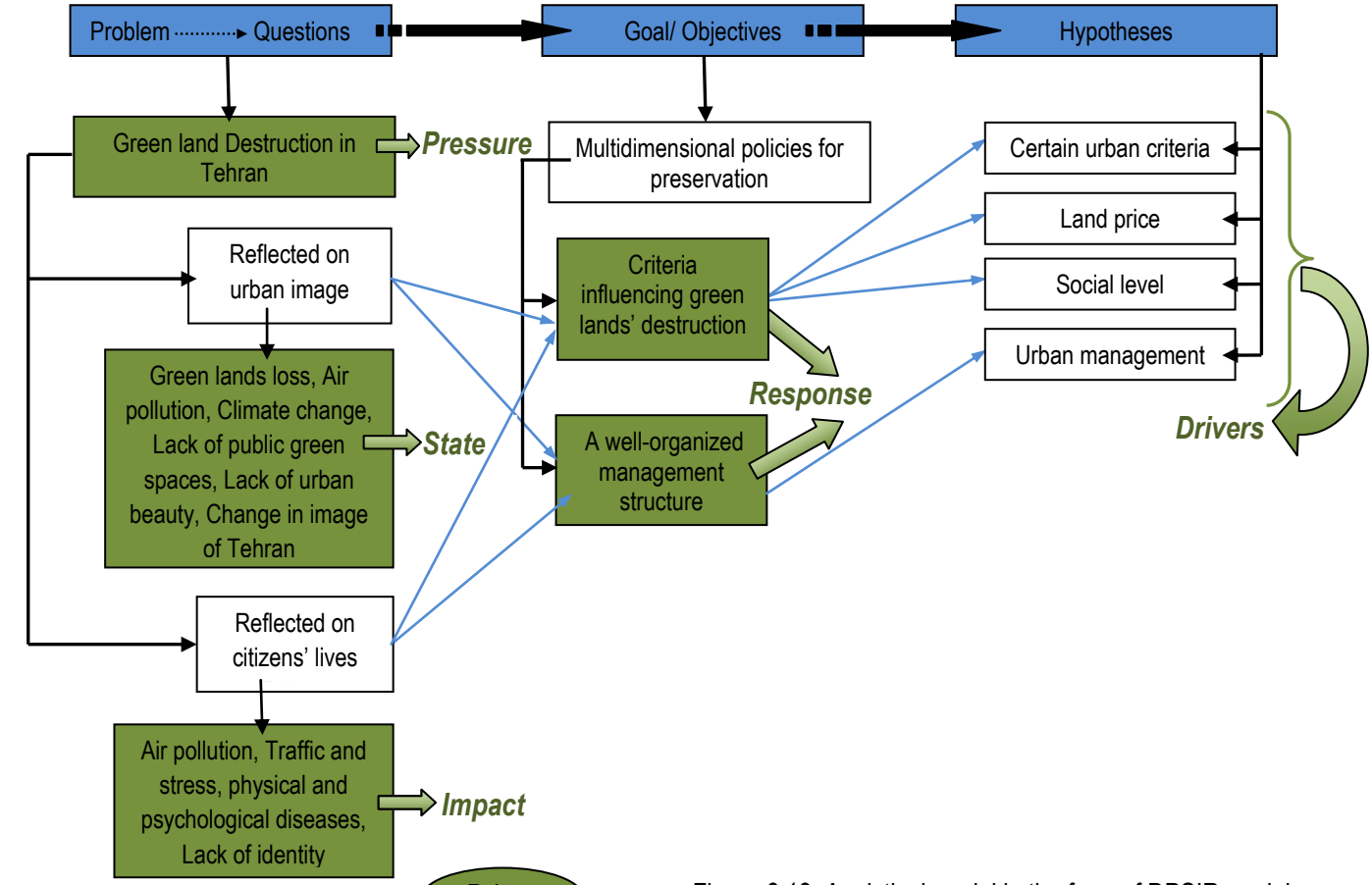
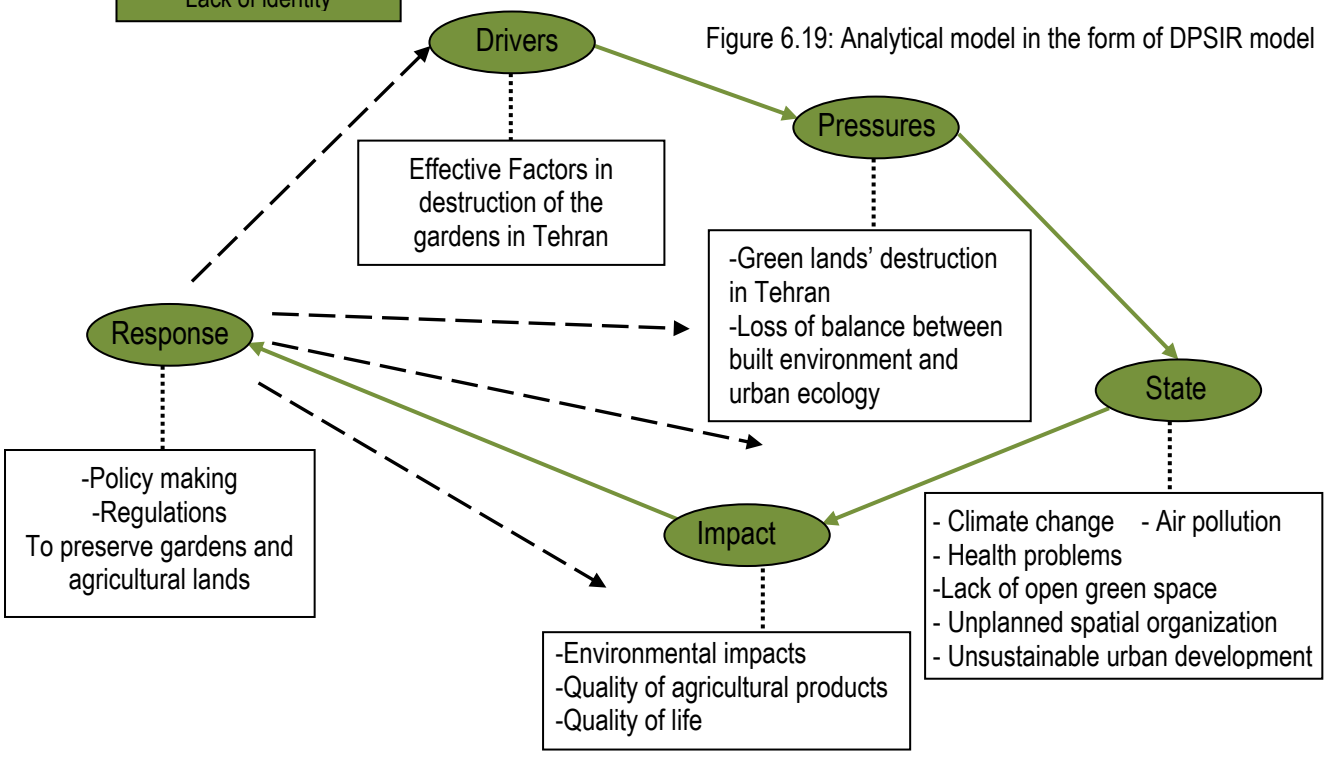


Figure 6.19: Analytical model in the form of DPSIR model



Source: The author

In addition two objectives arise from the mentioned goal; to approach a set of criteria which accelerate green lands' destruction and to design a well- organized management structure. Hypotheses state that these criteria can come from different fields of study and influence an urban problem and can be well managed with a suitable urban management structure. As shown with the blue arrows there are always interactions between the problems, questions, goals, objectives and hypotheses and they have interdependencies.

Two implicit points are within the content of the model; the first one is the sustainable approach in the whole structure. As sustainable development has been defined as the core theory and the main approach of the research, the illustrated system tries to take all four dimensions of sustainable development into consideration. Economic, social, institutional and environmental. The second point is that by comparing the research elements with DPSIR[1] model (green color graphics and notes in figure 6.18) and taking the compatibility of the research with this model into consideration (described in 6.2), the whole figure can be transformed to a new model and better perceived as shown in figure 6.19. In this figure the elements of DPSIR model has been extracted from the content of the system and it is shown that the analytical model can be adjusted on a new environmental model. In addition since the title of the research will conclude with policy making this model as a policy making framework is suitable for the last chapters.

6.4 Deriving criteria from research chapters

The outcomes of the previous four chapters and sub-chapters can be summarized in a set of criteria which are the effective factors in green lands' destruction in Tehran. The territory of these criteria is not limited to one aspect but comprises all aspects and dimensions of the urban issues. This stems from the multidimensional essence of the whole research.

On the other hand, the types and scope of the criteria is according to the theoretical basis of the research i.e. sustainable development. Four dimensions of sustainable development are within the content of the research from the beginning to policy making. In other words, there are socio-cultural, economic-financial, Institutional-juristical and eco- urban criteria the influence of each on the gardens and agricultural lands' destruction could be proved.

In this part, a model will be illustrated according to the criteria which have been extracted from different debates of the dissertation. The goal is to show that green lands' destruction should be observed as a multidimensional subject; therefore the factors and solutions cannot be confined to one field. There should be a holistic understanding for this urban issue and simultaneously a multidimensional approach to have a different point of view from other preservation projects in Iran and to have more certitude of success. Figure 6.20 illustrates the various criteria derived from each chapter. This figure has been made by the author according to the studies of the first 5 chapters and thereafter has been completed and developed during the questioning with the experts in the methodology phase which will be thoroughly explained in section 6.5.

The filling colors in the model of figure 6.20 show the interrelationships between criteria from different groups which emphasizes the interactions between criteria from different factor categories and highlights the multidimensional character of the research.

As an example the green box ( ) describes the interrelationships between criteria in different socio-cultural, economic and legal factor groups. It shows that a fast and unplanned urbanization and simultaneously rapid population growth forced the planners to give in short-term legal solution to constructions; therefore paragraph 269 and 329 emerged in the law and give the permission of 4 to 5 floors building to all the people in Tehran. This itself led to more land speculation and together with economic sanctions, building industry became the first national industry. As a consequence selling more densities had to be permitted to boom the main industry of the country and more gardens were destroyed to construct high-rises and help this procedure. The purple boxes ( ) show how social levels can impact economic factors in garden destruction.

[1] Driver, Pressure, State, Impact, Response model which has been defined in previous sections.

The Effective Factors in Destruction of the Gardens and Agricultural Lands in Tehran

Socio-cultural Factors

- Fast and unplanned Tehran growth
  - Introduction of the suburban gardens into Tehran
  - Underdeveloped spatial organization/ business and activity centers
  - Formation of city centers in north of Tehran in contrary to Master Plan
- Population growth
  - Request for living/ activity space
- Job and social level
  - Buyer/ developer
    - Wealthy
  - Owner/ Seller
    - Rich
    - Wealthy
    - Local tradesmen/ Bazari
    - Upper-middle class from previous regime
- Missing emotional relation to the region
  - Immigrants
  - Non-native residents
  - New rich
- The owners' generations change
  - Disappearing of Villa-dwelling life style
- Missing the participation of people
  - Lack of NGOs
  - Lack of survey mechanism for urban projects/ cost-benefit analysis
  - Lack of people's control on urbanism/ surveillance on organizations

Economic-financial Factors

- Financial issues of municipality
  - Financial guidelines
    - Not allocating land assets to investments
  - Financial un-sustainability
    - Lack of separate specific budget
    - Municipality revenue
- Land speculation
  - No added value for green parcels
  - The huge difference between the land price and apartments
- Building industry as the main national industry
  - Land use conversion
  - Density sell

Selling Density= booming construction industry

- Lack of closed system for financial tasks of gardens (Garden Bank)
  - Lack of Transferable Development rights (TDR)
- Lack of organized Tax system
  - "Adjacent to Green" tax
- Financial issues of the owner to keep the garden

"Master and Detailed Plan Production Organization" is dissolved

- Weak impact/ function of City Council
- Lack of surveillance on municipality
  - "High Council of Surveillance on Tehran Expansion" is dissolved.
  - Lack of incentive/deprived regulations: Presence of preventive ones

Institutional-Juristical Factors

- Malpractice of the article 14 of Urban Land Regulation
  - Unclear function
  - Power with no boundaries
  - Lack of surveillance body
  - Weak function of Ministry of Environment as a member
  - Presence of municipality in commission
  - Land use conversion from green to Non-green
- Paragraph 269 and 329
- Commission Code 5
- A comprehensive definition of "garden" based on land cover
- Lack of "Ersatzflächenpool": keeping the balance between green and built environment
- Commission Code 7
  - Lack of land cover in "Garden" definition by law
- Commission Code 100
  - Lack of surveillance body on the Commission
- Lack of independent organizations for gardens
- Allocating the gardens' responsibilities:
  -surveillance
  -legal
  -financial
  -implementation

Eco-Urban Factors

- The weak position of gardens in Master plan zoning
- Flexibility in Detailed Plans
- Parcels with no land use
  - Often changed to non-green
- Same approach to different kinds of ownership
  - Private
  - Public
- Permission for high-rise/ high density
- Parcel form
  - Fragmented
  - Connected
- Lack of "Garden" land use in plans
  - Lack of ecological network of Tehran
- Agricultural products ruined by air pollution
- Urban land use of green parcels
  - Barracks
  - Cultural
  - Health
  - Educational
- Lack of hierarchical preservation plans according to urban scales
- Insufficient water resources and destruction of Qanats system
  - High-rises with deep Cellars/ Parking lots
  - Road network in master plan from west to east
  - Construction of west- east tunnels
- Unclear urban ecologic data of gardens (Archive system for gardens)

Figure 6.20: Criteria and AHP model

Criteria extracted by the author from the research studies/ Literature Review

Criteria added by the experts during the interviews or by questionnaires

Horizontal inter-relationships between the extracted criteria in different factor groups

The wealthy people who enter the green land destruction cycle can be tradesmen (Bazaris) which are a social group that might be active in the process. As there is no organized tax system for this class of society, it is not easy for government to control their money and they often invest on the main industry of the country which is construction. Consequently, when the developer has enough money to convince the deal of buying the gardens, the middle- class seller will be indirectly forced at the end to sell his green parcel. If the people of this class are the owners themselves, the process is easier because they usually buy the piece of land as an investment and there is not enough emotional relation to the garden- house or the neighborhood for them. Thus different cultural, social, economic criteria in different scales from neighborhood to national level have correlations and inter-relations with each other and ownership is one of the factors that influence garden preservation.

The purple-pink colors ( ) are also horizontally connected and indicate that financial problems of the municipality which is an economic-financial factor leads to the formation of the commission 5 (and 100 that is also shown in another color) which can help the city cover some of its expenses. On the other hand the permissions for high-rises will be easier issued to bring revenue and solve the financial problems. Both of these solutions are the reasons that more green lands are being destroyed in Tehran.

These boxes ( ) show that in all the factors in different dimensions there are deficiencies in urban system and plans in Iran. Because of weak or weakly implemented during the rapid expansion of Tehran, the spatial organization of Tehran and consequently the business centers have been underdeveloped. This fact led to the formation of the city centers in the north of Tehran in contrary to what was intended in the Master plan. On the other hand in the zonings of the Master plan the gardens do not have a particular zone and in the detailed plans or in other urban plans produced in Tehran “Garden” land use is not commonly used. When this layer is not defined, a production of an ecological network cannot be expected. Moreover, due to the lack of this basic data in anecological-urban system there are no hierarchical preservation plans as they have been discussed in successful case studies in the world. TDR and Ersatzflächenpool which are based on these data cannot be implemented. In reality, all these criteria should be improved in the urban system of Tehran by redefining the meaning of “Garden” according to its real land cover. As described above, these fundamental deficiencies in the urban system function like a causality-issue thread in all the factors, influence the whole system and has impact on green land destruction.

The blue criteria ( ) indicate that on all different levels and with different factors there is a lack of surveillance in Tehran. There is a weak surveillance on the municipality and on the Commission Code 5 and 100 as well. On the other hand and similar to the Essen case, there is no public control of organizations and the public ideas do not have an impact on urban plans. There is no survey conducted by the municipality to see if people agree with expensive urban plans and what their priorities are. This lack of the public control in Tehran paves the way for the green land destruction easier.

6.4.1 The description of the effective criteria in the model

The graph in figure 6.20 is divided into four main categories which emanates from the theoretical basis in chapter 2. Four dimensions of sustainable development have been transformed to adjust to the current research objectives and cover all the factors gathered in different phases of this study. The criteria have been derived from the research studies and the literature review, from comparative studies and aerial photos analysis as well as the interviews, questionnaires and meetings with the experts.

Socio-cultural factors: The emphasize of the research on cultural and social issues in Tehran which led and is leading to green destruction can be reflected in this group of criteria. The first criterion tries to explain the time when Tehran broadened its boundaries without any strong surveillance and management in 1980s. The spatial organization of the city could not grow according to urban plans. In contrary to the guidelines of the Master plan which had foreseen the city centers more in the center of Tehran, the new business centers have been formed in the north. This rapid urban sprawl was the reason for and the result of many immigration movements to Tehran which brought along plenty of requests for space and activity space inside the densely built Tehran. Since the

existing apartment styles and villas could not fit the demands, the developers try to make infill development using the air density (high-rises) in the place of gardens which were the best huge available spaces inside the city.

Population growth as the second criterion in this category has been the other reason for the increasing demand of space (see the statistics in chapter 3). In addition to the reasons explained above, the incentive population policies of the government after revolution have been quite effective..

Job and social level as the third group of criteria is divided into 2 different groups; buyers who are most of the time developers or their partners and sellers who are the owners of the gardens. The buyers are wealthy business men or real estate managers; they come from different social levels but, most of the time, are not well-educated. The owners mainly comprise two different groups: the local people of the region who are the middle-upper class, most of the time related to the previous regime and in most cases well-educated; or the new-rich/business men who have been described by Harvey theories in chapter 2 and socially been characterized in chapter 5. The deal is almost clear because the buyer has the unlimited source of finances and can catch the owner's interest by higher and higher offers. The profit after developing the garden parcel is so high that many buyers give very high offers for the land and thus become developers-speculators as Harvey explains. That is one of the reasons of the regional inflation, and consequently land speculation controls the real estate market.

Various social groups that in better words attacked the regions with green lands especially region 1 brought along the lack of identity and thereafter no sense of belonging to the neighborhood. This is absolutely normal because many of the residents are either immigrants from other cities (mostly in the southern regions with farmlands) or from other regions of Tehran (mostly in the northern regions with gardens) or new rich. Thus, not only native residents weaken the emotional relation to the garden-villa or farmland life style. These feelings which can be categorized as a cultural issue can sometimes be as destructive as economic forces. Most of the time there is no support from the residents to keep the green spaces; many of them are open to more discussions on money, whereas, in a generation before nobody wanted to lose his grandfather's house by negotiating on financial terms.

This generation change after the revolution and the emerging new values and visions of the young people are as well criteria of the garden destructions. Big families living in garden-villas or farmlands have been dispersed after the revolution. On one hand, many of the family members/children migrated abroad, many others did not want to have a big family house but preferred a separate, independent and small apartment which they can afford when they start their lives. They did not like the traditional way of living and wanted to form new modern values in their family lives. On the other hand, the parents could not be left alone in a big garden and when they passed away, no child could stay in the big houses and pay the extravagant costs. In the case of farmlands, the children did not like to stay farmers in a big city like Tehran with its modern attractions and business markets. In addition, the costs of life without government supports could no more be covered by such jobs. Since the big garden/farmland parcel could not be divided into several pieces among children to give equal shares to the heirs, the only solution was to sell the parcel and divide the money among the children. Therefore, this cultural transformation of life style and values came as a negative criterion in the cycle of green destruction.

The last socio-cultural criterion is the lack of people participation which can be an effective driving force in leading the urban developments. There is a lack of mutual relationship. Neither people nor the government shows lots of interest in building up this participation. On one side, residents still think that they cannot have big influence on the top-down decisions which have been made. This usually comes from lack of knowledge and not believing in the people's will to form the built environment in the cities. On the other side, there are not enough grounds prepared by the government for the people to participate in their city planning. For instance when an urban project wants to be implemented, there is no social cost-benefit analysis or any survey conducted by the city to evaluate residents' ideas and desires for such big investments. This debate has been fully explained in the comparison studies of this research by comparing Tehran and Germany. The legal right that German residents have on complaining to the court regarding an urban project shows the power of people in city planning and is an automatic control on the authorities. If there is social surveillance, there normally will be fewer mistakes. As a result, the activities of NGOs are very weak in Tehran which can have a big impact on preventing green lands' destruction. The second type of criteria is categorized as economic-financial factors which comprise six main

criteria and several sub-criteria. The financial issues of the municipality are one of the most significant causes of green destruction in Tehran which has logical reasons. Municipalities need a certain budget or financial support to supply the city with urban services. This system is different in different countries; Even if it was more than 100 years ago that the first municipality has been established in Iran, i.e. in the city of Tehran, there still is no certain financial reference on the national scale that is allocated to municipalities' service activities.

Since 1983 and after the decrease of the oil prices, it has officially been announced that municipalities should follow an independent financial policy. This was a new economic national policy which brought a lot of difficulties to the financial sources of municipalities. Before the revolution, the government covered more than 50% of the municipalities' charges for the city but after this date, especially after 1989 that this regulation has been fully followed, the municipalities faced serious complications for providing the residents with the sufficient and good quality urban facilities. In practice, there is no specific, clear definition for the revenue structure of the municipalities on the macroeconomic scale in Iran, and being independent has made their status so unsustainable that they seek every couple of years for the new ways of having an access to money and managing the city. They have started focusing on different taxes and profitable construction projects that may sometimes be in conflict with residents' health.

Each municipality has special financial guidelines which do not allow to sell its properties, which are not few in Tehran, to be able to manage the city costs. Due to the high immigration and the need for new human settlements, the best way to invest money has been the triggering the construction industry and the selling of the extra building density or so called air density. In practice, this policy became the main income source for the municipality since 1989, and that is the reason why in aerial photos analysis a high speed construction development has been observed in the period of 1989-2000. Due to the political sanctions the country does not offer many productive areas to invest and consequently the construction industry gained the first priority. There is another point of view which some experts expressed in their interviews for this research; since the municipality wants to sell densities and cover most of its charges from this resource, building density and land speculation has to be the most important industry of Iran. Without this business, the cities will no more survive and the residents' needs cannot be provided. Beside density sale, land use conversion came on the list of, the money generating resources for the city to be discussed in Commission Code 5 (juristical factors). As shown in figure 6.21, the biggest financial resources of Tehran municipality have been building density and land use conversion with a big difference to the others.[1] Table 6.1 shows how fast density tax got popular in Tehran municipality system since 1941. As it is clear in the table since 1991 and the passed regulation of the independency of the municipality the use of this resource increased so dramatically that the number of parcels compared to the last decade has increased by 1000 times. There are different unsustainable ways that municipalities tried to discover to cover their expenses. Selling parking permission is another action which destroyed the traffic network and the image of Tehran. In 1990s Tehran municipality relinquished the necessity of sufficient parking lots for a building by paying the fine instead. As a result, many of the new apartments have been built without enough places for the residents' cars. This was the time that many streets and small alleys of Tehran, especially in region 6 and 7 which were being rebuilt at that time, turned into parking places. There is not enough space for pedestrians to find their ways in the unclear ways of the parking lots and pavements. Giving the extra floor area permission and land divisions turned Tehran image into a city with tiny parcels and high buildings. Neglecting security and hygiene weakened the whole function of the urban buildings and put the residents' lives in risk; urban and security regulations concerning enough light, space and air for human beings could be paid and bought as well.

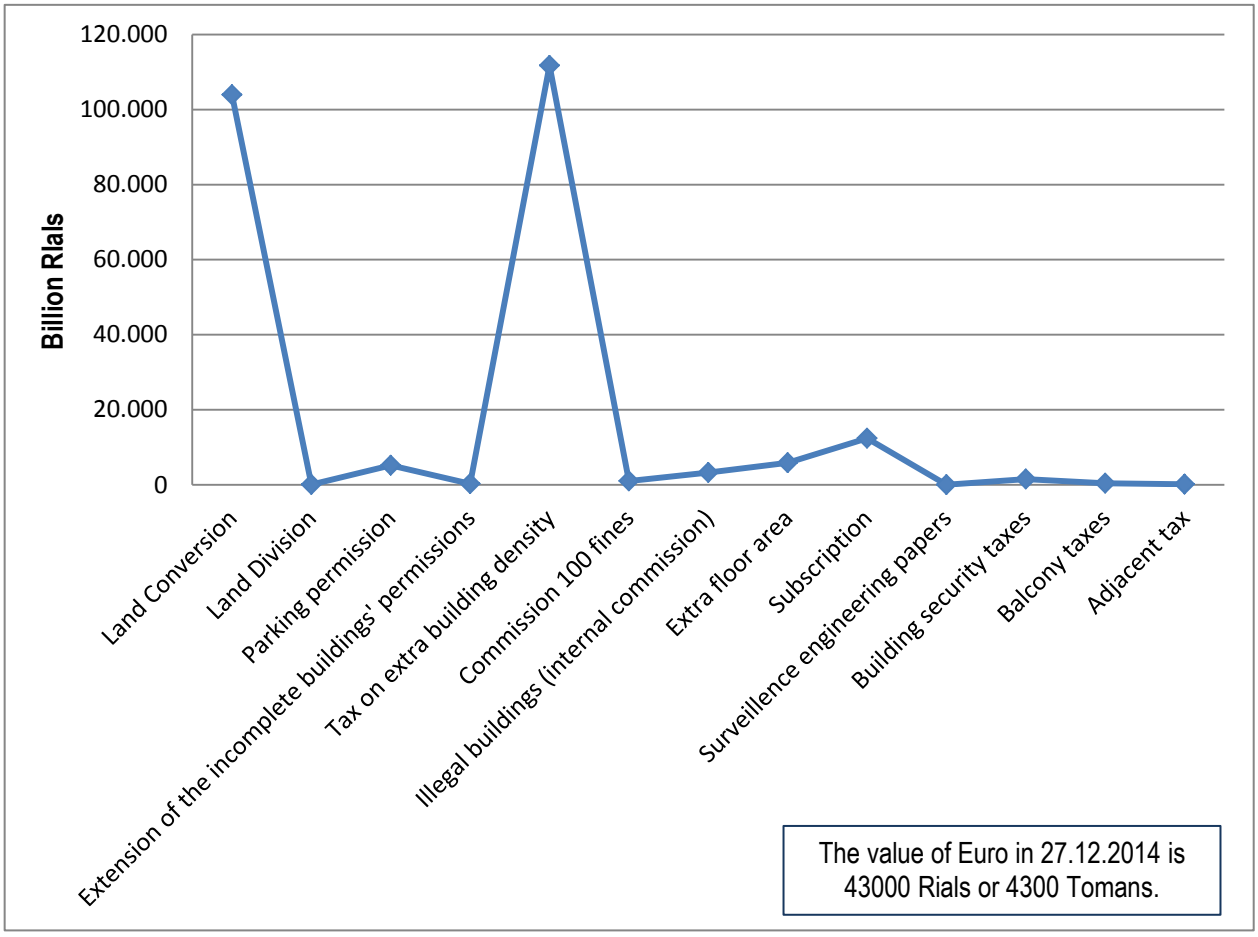
[1] The value of a Euro in 27.12.2014 is 43000 Rials.

Table 6.1: The revenue stemming from extra building density tax for the municipality of Tehran (1941-2014)

Year	Revenue (Rials)	Number of parcels
1941-1951	126,886,195	8
1951-1961	2,953,179,272	151
1961-1971	64,612,797	10
1971-1981	728,379,157	22
1981-1991	66,067,670	12
1991-2001	959,783,927,340	12,845
2001-2011	127,087,288,927,513	193,288
2011-2014	111,732,440,792,468	102,166

Source: Tehran municipality statistical yearbook

Figure 6.21: Tehran municipality unsustainable revenue 2011-2014



Source: Tehran municipality statistical yearbook

One of the most creative taxes is the Adjacent tax which means when the municipality widens a road or alley and as a result a parcel will locate adjacent to the road network border, it will get extra value and therefore the residents have to pay this added value as a tax to the municipality. If this concept has been accepted and executed in Tehran, then it is not possible to get taxes for the people adjacent to gardens which municipality has to take care of? This can be stated in another way; why a commercial parcel can obtain lots of extra value but a garden has been a symbol of a land which does not bring any profit and charge the owner more costs to be

preserved and kept. If there could be a mechanism of social justice in the system, it could have formed a tax which had to be gained from rich people using the beauty, fresh air, green space, birds and the unique characteristics of the adjacent garden. This tax could have been gathered for keeping the garden alive and considered as the added value tax of gardens. By this incentive policy people would not like to get rid of garden land use. The feasibility of such a system will be explained in the last chapter.

Note that land market is not just supported by the municipality but as explained before in chapter 5 the huge profit from construction has absorbed many developers-speculators by this business. This debate has been described theoretically in chapter 2.

Another problem here is that taxes are not invested in the direction of the fine; in other words, parking taxes gathered by the municipality are not used to make a small local parking for the residents in the neighborhood but are rather used to construct a highway in another district of the city. By considering figure 6.21, it is obvious that anything that is related to building construction brings money to the municipality. It is not only density tax, but the parking lot, the extra floor area, the illegal buildings and commission code 100 and anything which stimulates land speculation and are advantageous to the municipality function. Thus, when there is an economical slow down in the building section, municipality has serious problems to cover the city requirements. In addition, the quality of the services has to be reduced to match the remaining budget. Table 6.2 shows the same unsustainable financial resources in the three selected regions of Tehran. Selling density in region 1 has brought the biggest amount of revenue among all unsustainable financial resources in the three regions. Thereafter comes region 2 and with a considerable difference is region 18 on the list. This stems from the high-rise constructions and shows how beneficial this industry for the city is. The second source of finance for the three regions is land use conversion which has the same order. However, the differences between the amounts in the regions are enormous. Parking permission and the security charges have the highest number in region 2. This shows that many parking lots in region 2 have not been built and the buildings do not follow the security standards completely. In region 18 the illegal buildings which have been approved by the internal commissions in the municipality generate more revenue than two other regions. Apart from the mentioned items, region 1 is on the top of the list.

Table 6.2: The unsustainable financial resources of region 1, 2 and 18 in Rials (2011-2014)

Unsustainable financial resource	Region 1	Region 2	Region 18
Tax on extra building density	29,972,892,453,701	20,700,824,779,978	866,414,139,593
Land Conversion	16,291,850,099,583	8,288,906,738,435	1,484,686,790,369
Land Division	8,165,146,729	5,992,851,684	5,456,121,530
Extension of the incomplete buildings' permissions	67,844,517,880	16,144,903,898	233,838,746
Commission 100 fines	195,660,065,702	85,384,391,948	24,133,665,469
Adjacent tax	49,061,507,449	213,307,000	5,636,961,883
Extra floor area	2,099,811,306,897	526,993,347,481	36,956,256,506
Illegal buildings (internal commission)	21,795,522	41,250,000	18,910,690,894
Building security taxes	243,583,453,857	289,430,413,012	21,099,552,336
Balcony taxes	73,749,368,577	56,969,509,592	3,364,541,763
Parking permission	451,037,788,603	509,127,780,752	93,568,572,961
Subscription costs	2,256,096,758,892	1,140,688,579,937	78,558,523,746

Source: Tehran municipality statistical yearbook

In general, the approach of municipality to tax has to alter. Tax or fine is when there is a fraud or unfair action towards other people's rights and it has to be in a way that there could be a minimum guaranty that it will not be

repeated. It should not be taken as an amount of money to let the guilty person continue his mistake. Instead of earning money from giving building permissions to the high-rises, the municipality should generate finance from fining the owners due to not taking care of the green land which has public benefit. This fine can be persuading when most of the owners intentionally leave the trees to dry out (or dry them out themselves) because they know there will be a further cooperation in giving the construction permission to such parcels with the fine compensation.

The forth criterion which can be explained in this group is the lack of a comprehensive database with a closed system for all the green lands of Tehran. The preservation process in all the universal case studies could not be successful without the exact information on the green lands' qualifications. If the status quo data are not gathered thoroughly, any analysis or policy will be based on a deficient basis. However, the Parks and Green Space Organization claims that it has a garden data base which cannot be given to public due to privacy issues. Even if there is a data base either in that organization or any private consulting company which has tried to accomplish that (Bafte-e-Shahr Company), they are being kept so classified which makes any cooperation difficult. In addition, there is no murually agreed definition in all of these attempts about the term "garden". Since the base of any policy making is a complete documentation on the status quo, any comprehensive policy, system or preservation tool such as TDR[1] can hardly function efficiently in Tehran. That is the reason that in chapter 5 all the green fields of the selected regions have been studied one by one and categorized in 10 different classes. Gardens have to have a separate financial book in the closed system which can be called Garden Bank. The profits made by them have to be invested in their preservation procedures and not in other urban services such as making a high way.

The other criterion which is not unrelated with the above debates is the lack of organized and equivalent tax system in Iran. This problem stems from the absence of a thorough registered income or financial system for the residents. Except the official jobs in public places and many of the private companies, the other jobs, especially tradesmen in the market which earn much more than employees, do not have a clearly declared income. Social justice which has been explained in chapter 2 can very well be observed in this part of the study. Even though the new-rich, developers- speculators and business men have a lot of earnings, the tax system does not claim equivalent amount of tax from their cash in hand. In contrary, the employees with the fixed clear monthly income have to pay sometimes up to huge amount of their salary as tax. If each resident had a registered complete financial system, the profit of destroying the gardens and making the high-rises could have been saved as tax for preserving more gardens or expanding new green spaces. In better words, a part of the profit that speculators currently receive completely could have entered the close garden bank system and been invested for green lands projects.

Apart from the financial problems of the municipality explained above, the owner has certain financial problems which are very effective in the garden-destruction cycle. In the past, as shown in 1955 aerial photos in chapter 5, the garden owners used to have Qanat water or wells (almost free water) to irrigate their gardens. This system has been functioning for years till the last decade when the wells and Qanats streams have mostly been destroyed by urban projects and by overusing them. Consequently, accessibility to the water resources turned to be one of the main costly complications of keeping a garden or farmland. In addition to the costs imposed by the lack of water resources, gardening and farming have hardly any financial justification in a new modern city of Tehran. Many universal case studies in chapter 4 had the same problem in the beginning and by justifying the importance of the local farming and producing food for the residents without extra costs of importing or transportation, the government decided to support them in a way that they prefer continuing their career instead of building apartments and enter the speculation market. If there is a wave of supporting local/national food as many countries have started that, the food will be less expensive, fresh and more sustainable in terms of consuming less energy to be at the market. The final costs of production will be less as well.

[1] Transferable Development Rights

The third sets of criteria are under the name of institutional-juristical factors because it has become clear in the universal case studies and Iran that law and organizations are inter-related and the essence of the function of any organization is based on a written law which back up its legal character.

Institutional and juristical factors have such a big impact on green lands' preservation that in chapter 4, the whole juristic system of Iran and Tehran has been explained. According to the outcomes of this chapter and the interviews with the authorities in Road and Urbanism Organization, the regulations regarding preservation and the institutions responsible for them have many deficiencies which have to be improved. A new thorough definition of garden is missing which has to be followed by all the authorities and organizations in different fields and levels. This definition has to zoom out from land use and focus on land cover and the reality on the urban parcels. This can hold any land use as green spaces, public parks, private greens (villas, gardens or agricultural lands), historical parcels, public organizations such as universities and institutional land uses, embassies and political land uses with gardens, any undeveloped green land with non-green deed/land use and any parcel with green land deed which has been left away and not being looked after by the owner. This is the general group of green lands which have to be preserved and in the second step they should be categorized according to their characteristics.

Most of the institutional-juristical criteria in have completely been explained in chapter 4. The core of the research legal problems emanate from two legal commissions, 5 and 100. As explained before the main authority responsible for land use conversion is Commission Code 5. By studying the Commission 5 approvals in the case study regions, three kinds of garden destruction can be recognized; first the parcels which their previous land uses were gardens, public parks, public green spaces and the commission approved the land use change to other land uses which were mostly residential. This type of conversion is also divided into two subcategories: The parcels which are green lands in reality (holding green land cover) and the ones which have legal green lands land uses (and therefore green lands deeds) but the land covers in reality are undeveloped/vacant lands left away by the owner. These kinds of parcels have usually poor quality of green texture because of the lack of care and control.

This category contains the parcels which are in danger because the owner and the municipality both do not have enough budgets to invest on the undeveloped lands to become parks or any other green land uses with no reasonable economic benefits. The first sub-category with the green land cover has just maintenance expenditures which are lower than making green lands out of undeveloped parcels. In addition, destroying an existing park and building an apartment instead ruins the whole image and publicity of the municipality among people (despite of this fact, some parts of the parks have also turned into buildings). In addition, destroying the gardens which are covered and surrounded by walls and have private ownerships are easier than public places.

The second type of destroyed green lands by the commission are the gardens which their current land use is non-garden (residential, service…..) but in reality the parcel surface is covered by trees and can be assessed as a green land on aerial photos but in this case the commission turns the land cover from "green" to "brown" without taking the current state of land into consideration. This leads to chopping off the trees just based on an old deed of residential land use. In this case commission 5 could have used his power and authority on the land use conversions in a positive way and consider these kinds of parcels as green opportunities of the city. However, land uses could have been converted with tree preservation which means to preserve the maximum number of trees in the parcel and change the use of the building. Instead of investing a lot of money to create green spaces on undeveloped lands, this commission could have used these "ready to use" parcels. Note that these cases cannot be reflected in the following statistics as they are registered according to their land use which is residential.

It has to be stated that Commission 5 has also changed some parcels' land uses from residential or public service to green space but by studying thoroughly through the documents of the approved parcels, it could be perceived that at least in the period of this study, there have been almost no residential building destructions for the sake of green spaces. The residential parcels which have been turned into green public parks have been mostly gardens or a piece of land with considerable amount of trees and plants in reality but the legal deed is residential or urban

service. However, the number of these kinds of parcels are also few and the 'green participation' of commission 5 is restricted to this kind of land use conversion.

The other point that has been derived by the author from the commission documents which can be considered as 'non-green activity' is as follows; although Tehran has had the Comprehensive Plan from 1964 and the detailed plans from 90s, before 2007 detailed plans there were still several parcels in legal urban maps labeled as "without land use". By studying through these parcels' documents, it is totally apprehensive that almost all of these parcels have turned in to "non-green" land uses in commission 5. In a city like Tehran that has been overwhelmed by houses and packed by traffic, there is no necessity of turning the "no-land use "parcels into residential ones. This fact could have also been implemented by commission 5 power in Tehran urban management.

Deeper study of Commission 5 approvals could be conducted through the author travel to Iran. The concrete documents of Commission 5 have been found in the form of two documents: Land use conversion approvals from Nr.340 to Nr.365- from 27 May 2000 to 22 April 2003 and Land use conversion approvals from Nr.366 to Nr.426- from 24 Dec.2003 to 21 Jan.2007

The first phase documents have been categorized by author according to the type of conversion as an example to give a better quantitative view of the green lands destroyed by Commission 5 in facts and figures. Tables 6.3 to 6.5 show these facts in three chosen case study regions of Tehran. Table 6.6 shows the comparative view between different regions in percentage. In the first step the whole surface area of the region and in the second step, the green land surface area of the region derived from each region's detailed plan has been used to complete this comparative study.
The other point explained in chapter 4 is the management structure of the commission which has to be modified if any further change in keeping the remaining green lands is expected. With municipality as the head of the meetings, most of the profitable land use changes have to be approved for the municipality financial survival.

As a result "economic sustainability "of the municipality must be considered as a crucial criterion to prevent green lands from being an economic source for municipalities. If the municipality is going to have the same power in land use conversion, it cannot at the same time benefit from this conversion. When the decisions taken in the municipality are dependent on covering city expenses, the urban planning techniques and the right policies are hard to follow. That is why the priorities should be re-clarified. Is people's health, happiness and comfort in urban life the main responsibility of commission 5 meetings or holding the balance of costs and benefits for the whole system to be more independent?

As a conclusion, the management body of commission 5 should alter. Municipality should not have the whole authority in the commission and simultaneously benefit from its approvals. Often green planning and economic benefit cannot be accumulated in one approval. Till the time municipality is not economically independent (no sufficient sustainable source of finance), it will follow the same policy. Therefore, the sub-criteria of "power of Commission 5" and "no surveillance body" for the commission have been defined.

To sum up the influence of the commission on green lands destruction in the three selected regions, it should be stated that in less than two years region 2 has lost 47,630,000 m^2 green lands. Region 1 comes in the second place with 45,733,200 m^2 and region 18 with 37,830,000 comes in the last place.

Note that this amount of loss is just under one factor (commission 5 approvals) and only in the period of just 2 years. Moreover, the residential land uses which had green land cover in reality could not be calculated in the statistics. So the real numbers are definitely higher because the garden definition does not cover all the green lands of the region. On the other hand, in a city like Tehran with dry weather, the total annual precipitation of less than 233 mm and the hottest days of up to 45 degrees, losing any square meter of green, impose high expenses to the government and municipality to compensate or recreate the same amount.

Table 6.3: Commission 5 land use conversion approvals between 2000 and 2003 in Region 1 of Tehran (related green land uses)

Previous land use	Approved Land use	Surface Area of the smallest parcel (m^2)	Surface Area of the largest parcel (m^2)	Number of parcels	Total Surface Area of the Converted Land use (m^2)	More explanation
Green spaces	Residential	235	8357	8	15778.52	
Public Park	Residential	-	-	1	Not mentioned	
Public services	Residential	67.59	2110.5	3	6298	
Total green land uses	Residential	67.59	8357	12	>22076.52	If public services could be considered as green lands for public, this could be claimed as the total green lands to residential conversion in Region 1.
Green Spaces	Sport	-	-	1	8000	
Green Spaces	Public Services	-	-	1	2256	
Green Spaces	Services	-	-	1	20927	One of the unique Examples: The conversion is approved only if all the trees are preserved.
Total green spaces	Other land uses	-	-	3	31183	This is the total green spaces ruined for the sake of other land uses.
Total green land uses	**Other land uses**	**67.59**	**8357**	**15**	**>53259.52**	**This can be assessed as the total negative conversion of the Commission in region 1 versus the last row.**
Residential	Green spaces	252	1708,2	4	9126.2	All four parcels have residential deed but their land covers are undeveloped lands, therefore no building was destructed for the sake of 'Green'.
Residential	Public park	-	-	1	806	The land cover is green space.
Total residential to green land uses	Green land uses	252	1708,2	5	9932.2	This is the total residential land uses which have been converted to green land uses in region 1, considered as a positive activity of commission 5.
No land use	Green space	1300	1500	2	2800	The both parcels have a large amount of trees.
Educational	Public park	-	-	1	3070	The land cover is a combination of garden with large amount of trees and an undeveloped land.
Other Land uses	**Green land uses**	**252**	**1708,2**	**8**	**15802.2**	**This can be assessed as the total positive conversion of the Commission versus row 9.**

Source: Author, derived from "Commission 5 approvals in High Council of Architecture and Urban Planning", Urban Analysis and Planning Company, 2005

Table 6.4: Commission 5 land use conversion approvals between 2000 and 2003 in Region 2 of Tehran (related green land uses)

Previous land use	Approved Land use	Surface Area of the smallest parcel (m^2)	Surface Area of the largest parcel (m^2)	Number of parcels	Total Surface Area of the Converted Land use (m^2)	More explanation
Green spaces	Residential	1530,404	10894	3	31216,404	
Public parks	Residential	1200	13000	2	14200	
Public services	Residential	1300	6072,85	3	9416.85	2 of the three parcels have been already built up as residential complexes with non-residential land uses.The third one is an undeveloped parcel.
Total of Green land uses	**Residential**	**1200**	**13000**	**8**	**54833,254**	**Total Green land uses to residential**
Residential and green space	Green spaces	-	-	1	=~10894[1]	This parcel has 3 sub-land uses: residential and partially green space and also no land use. The owner has accepted to give the green part and network to the municipality and receive the permission to divide the parcel to 16 residential parcels in return.
Educational, public park ,garden-residential	Residential	-	-	1	13100	Currently the parcel is occupied by the university and is a residential region with educational garden. The density of 70% and occupancy rate of 25% was approved.
Green spaces	Cultural-sport –commercial-institutional	-	-	1	5000,39	Despite the green space deed ,in both parcels there have been illegal constructions which was stopped by the municipality. Therefore they applied land use conversion in commission 5 to finish their buildings! The whole parcel was divided to different land uses.
Green space	Commercial-institutional	-	-	1	8000	
Green space	Sport-cultural	-	-	1	13000	
Total Green land uses	**Non-green land uses**	**1200**	**13100**	**12**	**93933,644**	**This is the total amount of green potentials in region 2 which were converted to non-green land uses by commission 5.**

Source: Author, derived from "Commission 5 approvals in High Council of Architecture and Urban Planning", Urban Analysis and Planning Company, 2005

[1]The approximately equal symbol is written because the separate amounts of surface areas allocated to each land use are not mentioned.

Table 6.5: Commission 5 land use conversion approvals between 2000 and 2003 in Region 18 of Tehran (related green land uses)

Previous land use	Approved Land use	Surface Area of the smallest parcel (m^2)	Surface Area of the largest parcel (m^2)	Number of parcels	Total Surface Area of the Converted Land use (m^2)	More explanation
Green Space	Residential	-	-	1	4350	
Urban Services	Residential	-	-	1	3123	Urban services can be considered as a green potential in a city.
Public park	Residential	-	-	1	9900	
Total Green land uses	**Residential**	**3123**	**9900**	**3**	**17373**	**The total amount of green land uses converted to residential land use.**
Public park	Green spaces and residential	-	-	1	Not given	
Public park	Commercial	-	-	1	6309.5	
Green spaces	Urban services	-	-	1	15580	The term "urban services" is general. Therefore it depends on the kind of activity it comprises. However, changing green space to urban service cannot be without destroying the trees and the author consider it here as a negative conversion by commission 5.
Green land uses	**Non-green land uses**	**3123**	**15580**	**6**	**=>39262.5[1]**	**Total amount of green lands destroyed by Commission 5 in region 18.**
No land use	Public park	991.5	8000	2	8991.5	
Sport	Public park	-	-	1	10000	
Non green land uses	**Public park(green land use)**	**991.5**	**10000**	**3**	**18991.5**	**The positive activity of Commission 5 versus row 9.**

Source: Author, derived from "Commission 5 approvals in High Council of Architecture and Urban Planning", Urban Analysis and Planning Company, 2005

[1]The area data the row 6 is not given; therefore, the amount calculated here will be definitely more than the number given.

All these arguments lead to the conclusion that the influence of this human factor (Commission 5) on destroying the green spaces in Tehran must be taken into consideration and could be avoidable easier than other factors because it is in the hands of municipality, urban planners and the managers who have the strongest power. Simultaneously, as explained in the international examples, this power has to be controlled by the residents because they own the city. When the statistics are observed more precisely, it can be perceived that there are different approaches in the three regions concerning land use conversions.

Region 2 with 47, 630,00 m^2 green lands loss has the largest amount of destroyed green lands by Commission 5 approvals in the mentioned time. Region 1 with 45,773,200 m^2 stands in the second place and region 18 with 37,830,000 m^2 the last. This comparison would not be the same if the green lands' surface area of each region is taken into calculation. Although region 2 has the most destroyed amount of green lands, in comparison to the whole green lands in this region, the least percentage of green land has been destroyed in this region. In contrary, region 1 has the highest percentage of green lands being destroyed by commission 5. Note that Region 1 is more densely built than region 2 and due to the high buildings and new apartments' constructions in the last decades in this region, creating green spaces when it is destroyed is almost impossible.

Table 6.3 shows other land use conversions in each region as well and is not just focused on the green land use loss in the region. However, table 6.6 is more focused on the results of the previous table. According to this table in region 2 larger surface areas of green lands have turned into residential land use in comparison to other regions and that can be because of the government's approach of residential complex construction in the last decades in this region.

In comparison, region 18 has more lands which have been turned into green lands and this conversion generates from the recent public park creation by the municipality in this region. It has to be highlighted here that this region is a mainly industrial-commercial one.

To sum up, it seems that region 18 policies were far from creating residential land use between 2000 and 2003, as the percentages by which different land uses have been changed to residential land use is lower than in other regions. Among all the statistics, changing green spaces to other land uses has had the largest percentage between 2000 and 2003 in all the regions. This can stem from the unclear definition of the term" Green space" in Iran urbanity as well. As it is nor private owned neither public park, thus, easier to change the land use.

Table 6.6: Comparative table between different regions' land use conversion, 2000-2003

Region / **Land use Conversion**	**Region 1** (m^2)	**Region 2** (m^2)	**Region 18** (m^2)
Total green lands to residential	22077	54833	17373
No green lands to green lands	15802	10894	18991
Green spaces to residential	15779	31216	4350
Public park to residential	No data	14200	9900
Public/urban services to other to residential	6298	9417	3123
Green spaces to other land uses (including residential)	46962	57217	19930

Source: Author, derived from "Commission 5 approvals in High Council of Architecture and Urban Planning" ,Urban Analysis and Planning Company, 2005

As a result, the land use conversion should be considered as one of the factors which had influence on the green lands destruction in Tehran. This conversion is allowed to be approved only by Commission 5. Therefore, this

commission and its policies, advantages and disadvantages, approaches in different periods of time which are also dependent on different economic, political and social situation of the city must be taken into consideration.

Commission Code 100[1] which has previously mentioned in chapter 4 is in fact the code 100 of the "Municipality Regulations" which has been approved in 1966. It got its power and importance after 1989 independency policies of the municipality. According to this code any construction or land division in Tehran has to receive permission from the municipality in advance. The initial reason of constructing this commission was to prevent the construction violations but in practice it turns to gaining fines, negotiating its price and let the builder continue his construction. These fines have been a considerable amount of money for the municipality and could cover around 9% of the total revenues for the municipality between 2001 and 2008.

Currently, there is no written reference for the exact definition of construction violations in Iran and this is one of the fundamental problems of this commission. In the sentence 2, 3 and 4 of this code it has been clearly mentioned that extra residential, commercial and industrial density, the construction of the buildings without previous permissions with taking into consideration health, technical and urban issues can be discussed in the commission and by the approval of the commission the owner does not need to demolish the built area but rather pay for the fine. In the sentence 5 the same strategy is given for parking lots and in 6, 7 and 8 almost all the main construction infractions have been included which means that except land conversion almost all others can be fined by this commission. This atmosphere has been mixed with the socio-cultural criteria explained in the first group of factors. The immigrations and rapid expansion of Tehran and consequently developers-speculators who used this commission to benefit more from the land speculation and constructions without paying attention to the quality of the buildings made the increment violations during this time. According to the statistics between 2001 and 2008, 278,893 cases of building violations with the total area of 18,404,229 m^2 have been presented in the commission. The documents show that in this period of time from each 2 approved building permissions one has been reported as violation to the commission 100 which shows a huge number of buildings. The most of these reports were the violation code 12 which contains the breach in urban regulations and national construction rules.

Gradually this commission became so common that it turned into an initial right of the residents which the municipality has gained from them and they have to pay the unfair fines to take it back. This mentality got so strong that the residents put some buildings on fire in Mashad and Arak, two big cities of Iran, to show their complaints against this commission's approval on demolishing a building. Currently, the main approvals of this commission are just the fines and destruction can rarely be found in the statistics.

By selling more building density and finding other ways of covering the expenses of the city, the role of this commission lost its significant share in municipality revenues (Table 6.8). This percentage has increased from 1983 to 1990 from 1.4% to 9.7% but in the next decades decreased dramatically when the construction revenues and selling density compensate this drop.

Table 6.7: The revenue share of Commission Code 100 and construction taxes (1990-2007)

Year	The revenue share from Commission Code 100	The revenue from construction taxes
1990	9.7%	43.1%
1996	1.97%	89.12%
2001	2,3%	89.62%
2007	2,08%	75.45%

Source: Rafiyian et al., 2010, p.181 quoted after Commission Code 100 statistics, 2009

Another important fact about this commission is that not only the fines bring along lots of money for the municipality, but also the agreements. By taking this fact into consideration, in 2007 the revenue that municipality

[1] The main source of the data on Commission Code 100 has been translated from Rafiyian et al., 2010. In addition, Mr. Majidi ministry deputy who teaches the regulations of this commission helped a lot by the interview.

gained from this commission including the agreements accounts to 8.95% of the total revenue in this year which is a high number.

This commission has direct and indirect consequences on the green lands of Tehran. The direct effect is the illegal buildings in the gardens which will remain by paying the fines and the indirect ones are in relationship with other factors explained in this section. Back to socio-cultural factors, according to a research conducted by Diargah Consulting Company in 2007, just due to the extra residential density in the period of 2001- 2008 which have been accepted and fined in this commission 117,726 persons have been added to Tehran regions' population which has not been predicted in the visions of the urban plans. This number of population requires urban infrastructure and services amounts to 1,449,209m^2. This directly booms the building industry and indirectly destroys the gardens.

The consequences of the Commission Code 100 relating ecological factors comprise air and sound pollution (caused by extra building density and population), the higher energy consumption, destruction of agricultural lands and green fields (caused by illegal constructions inside the green parcels). Therefore, a financial resource can be valuable for the municipality which does not bring along more costs to the city itself. The total costs of the solutions have to be taken into consideration. Moreover, the urban plans which have been produced with high costs lose their value when a commission can approve cases against them or not following their visions and suggestions for the city expansion.

Among institutional-juristical factors Commission Code 7 or Garden Commission, article 14 of Urban Land Regulation, separation of gardens' tasks in a new organization and Ersatzflächenpool have been thoroughly explained in chapter 4.

Paragraph 269[1] was the most effective approval of Commission Code 5 in 1997 for structuring the use of the extra building density in Tehran which reflected its effects on the physical, spatial organization and functions of the city in the short period of its life (till 2001). In spite of the goal of this paragraph which was to unify the fragmented constructions in the previous years, it was not successful because of its incompatibility with the environmental, ecological and spatial capacities of the city. In fact, the city needed a legal document before the production of the Comprehensive or Detailed plans and the goal was to organize the constructions in this timing gap. The building density in paragraph 269 is based on table 6.8. The parcels which are more than 600 m^2 and located in road networks equal or more than 20 meters width can be categorized as high-rises and not follow this paragraph but the rest of the parcels have to obey these regulations.

Table 6.8: Building densities in Paragraph 269

Parcel Area / Path width	Alley width > 12m	20m>Alley width >= 12m	Alley width>=20m
Parcel area > 300 m^2	One floor	Two floors	Two floors
600 m^2>Parcel area >= 300 m^2	Two floors	Two floors	Three floors
Parcel area >= 600 m^2	Three floors	Three floors	Four floors

Source: Sholeh, 2008, p.41

After the couple of problems brought by paragraph 269, the authorities tried to introduce another paragraph to Commission Code 5 in order to reduce the deficiencies of the last one. Thus, in 2001, paragraph 329 has been passed in the commission. According to the new regulations, the base density for the whole Tehran amounts to 120% and the occupancy rate 60%. The maximum extra floors that can be constructed by using the extra building

[1] The data on paragraph 269 and 329 has been translated from Sholeh, 2008 and by the great help of the interview with Ms. Yalda.

density allowed in this paragraph cannot exceed 3 floors. Moreover, the parcels located in the alleys less than 6 meters have to use the base building density which is 120%. Building 5 floors on the pilot or basement is permitted when the average floor area of the residential units is not less than 120 m^2 (in region 1 to 8) and 60 m^2(in regions 9 to 20 and 22). Four zones have been presented in this paragraph which tried to divide Tehran according to its spatial organization. Thus, before the legal Detailed plan for each region, the extra building density of 60% in one floor (more than base denisty of 120%) and the total of 180% is permitted in these 4 mentioned zones (table 6.9).

The consequences of these two paragraphs for the health and the quality of the city was so threatening that years after the improvements could not make any big diffrence. Moreover, after the Comprehensive plan the power of these regulations could not easily be deleted and many constrcutions still followed them.

Table 6.9: The building densities in Paragraph 329

Zone	The parel area (m^2)	The path width (m)
The north part of Tehran to Hemmat highway	S>=300	A>=12
The regions between Hemmat and Enghelab street	S>=250	A>=10
The regions between Enghelab, Shoosh and Saveh road	S>=200	A>=8
Shoosh and Saveh to the south boundaries of Tehran	S>=150	A>=6

Source: Sholeh, 2008, p.42

In general, the last point to mention in institutional factors is the surveillance bodies in urban management of Iran. The lack of vigorous, steady and comprehensive controls over different commissions (100, 7 and 5), organizations like municipality and Parks organization is obvious in the structure which brings several complications. On one side, city council as the surveillance body for municipality does not have enough power for this responsibility and on the other side the “Master and Detailed Plan Production Organization” and “High Council of Surveillance on Tehran Expansion” which supervised the urban procedures have been both dissolved. The existence of the regulations, laws and rules will not guarantee the correct implementation of them. The surveillance bodies have to be defined to control each phase of implementing the rules and assure that the regulations are being executed.

The forth group of factors affecting the green lands destructions comprises the urban and ecological criteria shortly called eco-urban factors. Concerning the urban plans there are couple of problems. The first one is that the gardens are not selected as a separate network in the master plan. In other words, there is no fixed comprehensive layer allocated to Tehran gardens which let the urban planners consider them as a crucial vulnerable preserved layer in all their decisions and policies. However, preserved zones exist but they have not been taken all the gardens into consideration and they contain other types of lands as well. What Tehran needs is a clear comprehensive layers of gardens and agricultural lands to be preserved in any urban project.

The second criterion in this group is flexibility in the Detailed plans which have been explained in chapter 4. Whereas the next one goes back to the time before the new 2006 Master plan when there were several parcels in the old plans of Tehran without any suggested land use. In spite of the fact that these lands were the suitable potentials for compensating the lack of green spaces in Tehran, in most of the cases they have applied for non-green land uses to Commission Code 5.

The other criterion which emanates from the legal circumstances of Iran is the ownership. Ownership is a very sensitive issue in Iran because it is based on the Islamic rules. In Islam ownership is holy and an owner has all the rights to his assets. This fact makes any interference in the garden issues hard but not impossible. These private assets are public filters of the city which are necessary for the lives of all the residents and as a result ruining them is equal to threatening others’ health in the city. In the very first steps this contradiction between

private assets and public health has to be solved. As it has been discussed in chapter 2, the research problem is not private but rather a global issue as it affects all the countries with climate change consequences. Thus, ownership has to be taken into consideration in the urban planning more than before. The first hypothesis of the research was that the parcels with public ownership have resisted better during the time. This statement has been proved in chapter 5 when the remaining parcels from 1955 till 2000 and by comparing with 2012 Google were mostly universities, hospitals, embassies and palaces. Nevertheless, during the questionnaire procedure by the experts, it has been stated that recently in order to get land use conversion, there have been many applications for educational land uses in green parcels. After couple of years the school is closed and the garden will enter the destruction cycle without the educational land use. Since converting a parcel to school land use is easier than residential, the experts have said that educational land use is more like an excuse for land conversion.

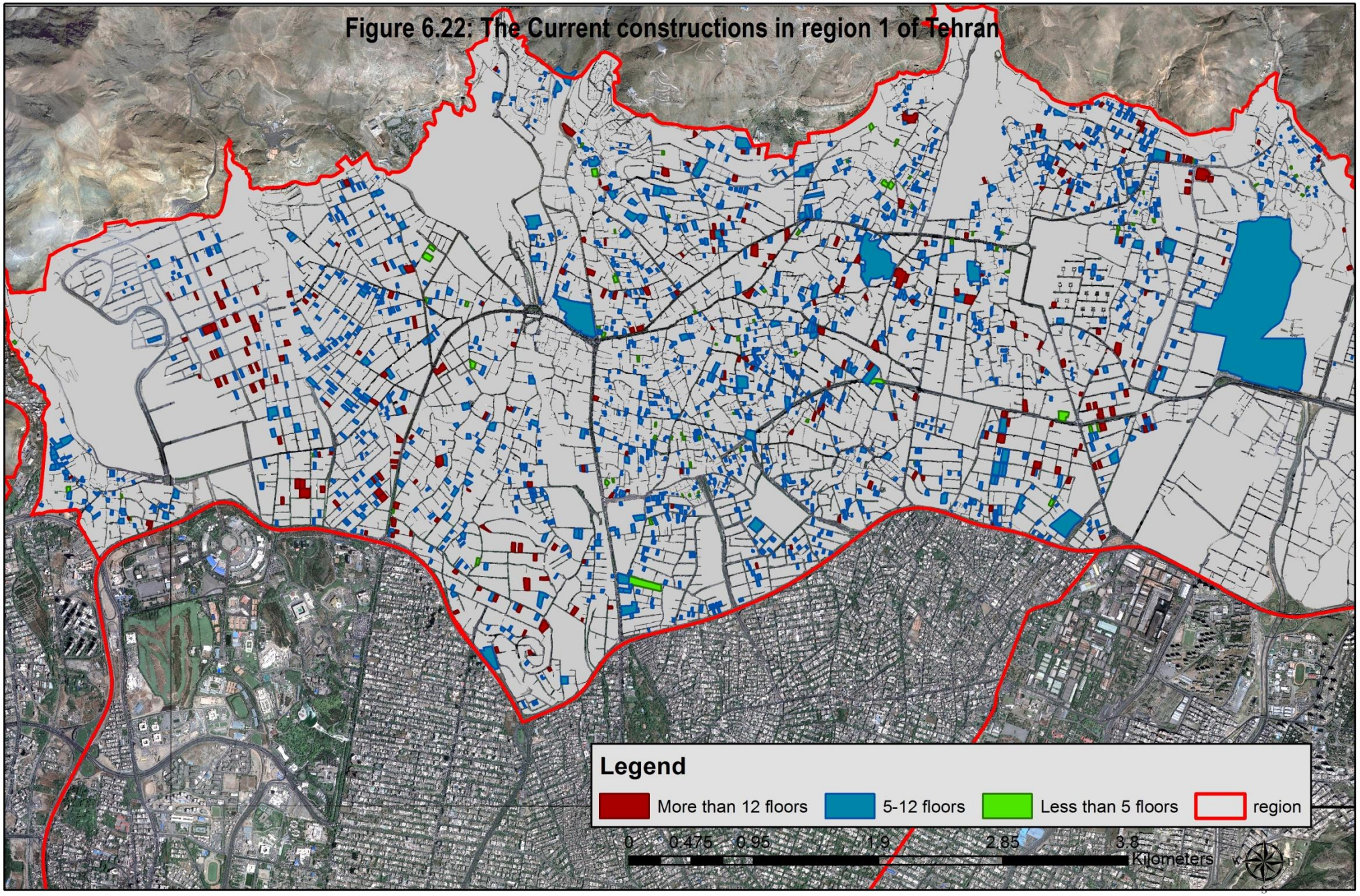
In the last Comprehensive plan in 2006, it is clearly stated that from this date no more high-rise permission will be issued by the municipality of Tehran for all Tehran regions. Nevertheless, this is what the urban plans claims and in practice Tehran is still being built as a giant vertical city. This fact has been shown in figures 6.22 and 6.23. In these figures the current constructions of region 1 and 2 which are the case studies of this research have been presented. The numbers of the buildings more than 5 floors and 12 floors are so high that can be clearly observed in the maps. Whereas, 12 floors-building and more is defined as high-rise in the comprehensive plan.

Green parcel form is one of the criteria which has been observed in the aerial photos analysis, successful universal examples and mentioned in the expert interviews. The parcels which are more connected to each other and form a zone or network are easier preserved or have survived longer during the destruction time. Therefore, if there are linear or a mass of gardens such as the ones along Darakeh in region 2 or Kan in region 5, the planner's ultimate attempt has to be to conserve the whole area as a zone. The moment one of the owners gets the construction permission, the neighbors will claim the same, which is not unfair either and the result will be the loss of a green region in the city. In addition, in order to reach the optimal goal, i.e. a green network in the city, the connectivity of the green spaces plays a significant role. Fragmented green parcels are not easy to connect.

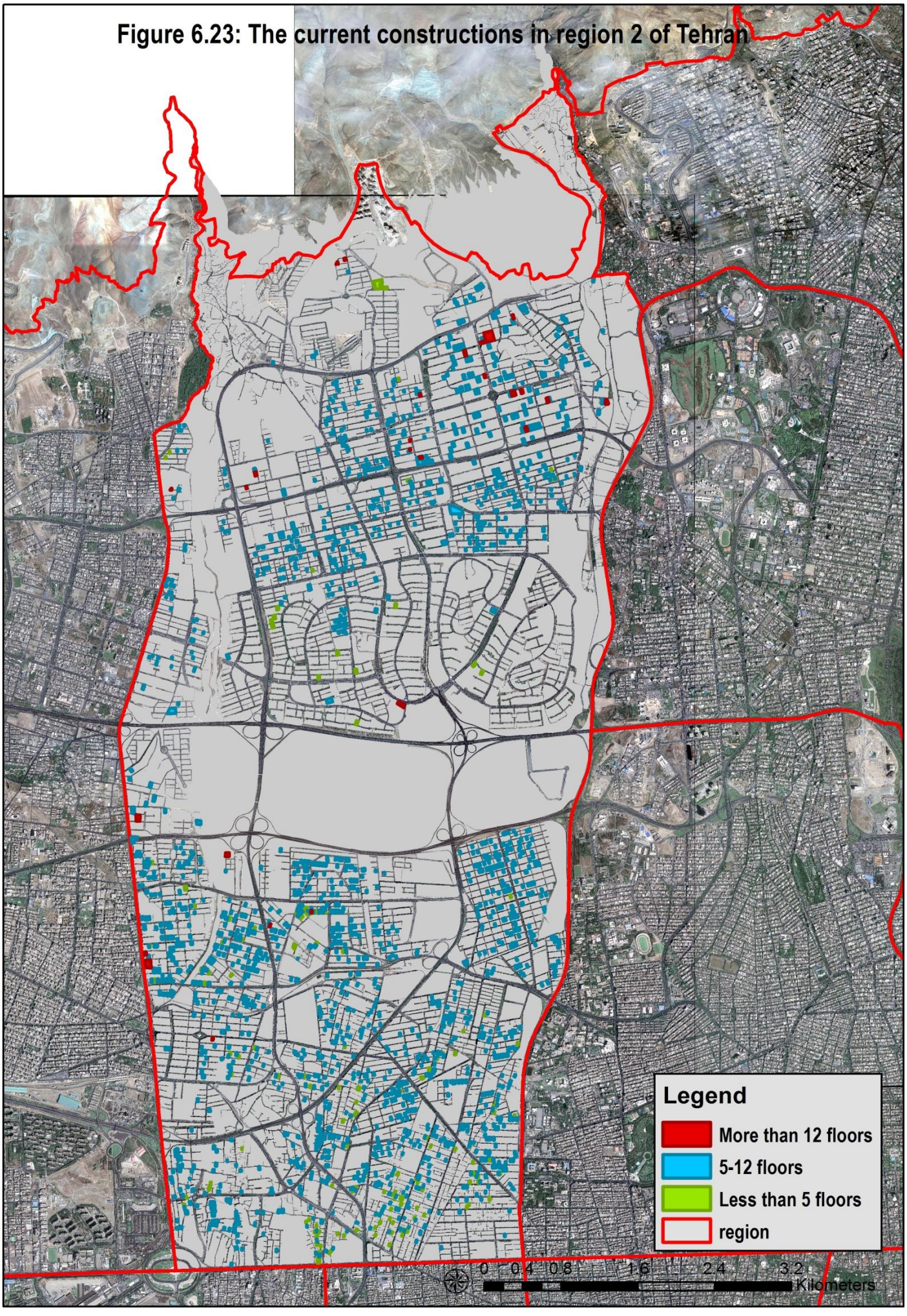
The other criterion which is related to the previous one is the ecological network which is missing in Tehran. In all urban plans there is no certain layer with the same and clear definition called "garden" which is a part of a bigger ecological plan. In other words, there is no plan with all environmental elements for Tehran similar to the ones shown in universal case studies. Thus, gardens and agricultural lands cannot have a legal formal document which defines their essence, place and quality. This plan can be connected to the garden bank explained in economic-financial factors.

Moreover, there is no green preservation plan in different hierarchies and different urban scales in Tehran as described in universal successful examples. If Tehran wants to preserve its green fields, this act has to be conducted from city to region, district and neighborhood level. In many cases it can be exacter and like Essen in Germany reach the level of tree preservation and the types which according to the climatic circumstances have to be strictly conserved. If this hierarchy is followed and each lower-level plan pursues the guidelines of the higher one, the success of the preservation is highly endorsed.

The lack of the clear urban ecologic data which is connected to the ecological plan described above is one of the other crucial criteria in eco-urban factors. There is no archive of gardens connected to an ecological plan which is based on garden bank and analyzed in a specific organization responsible for green fields of Tehran. This is how these different types of criteria can be horizontally connected to each other in figure 6.20.



Source: The author using the data from Paysa Company-Civil House 2014



Source: The author using the data from Paysa Company-Civil House 2014

The next urban criterion is what is called urban land use of the green parcel. This can be observed more in gardens than farmlands and is the main reason that the layer of garden in some urban plans has not been accepted and sufficient enough for this research. Using land cover and checking each parcel one by one in the three selected regions has stem from this dominant mentality in the research as well. There are many other land uses which have enough characteristics to be preserved like gardens. In other words, many gardens have given space to a second land use or an urban land use such as educational, cultural, health and barracks. According to aerial photos analysis and the interviews conducted with the experts, this land use has a big impact on preserving the garden. This criterion has a close connection with the ownership criterion which has been previously explained. The residential-gardens are easier converted to high-rises than hospitals or schools. The constructions in educational, health or barracks are more in a form of fragmented small rooms or tiny buildings for the function of new section, exhibition, security room and etc.

However, as explained in ownership part, in the recent years there cannot be a high certainty about these land uses either and there have been cases of school-garden destruction based on the expert interviews. In general, residential- garden with private ownership are the most vulnerable land uses regarding destruction and have to be preserved with strong, astute and attentive policies by taking many aspects into account.

Another ecological criterion effective in preserving the gardens is water whose importance has been thoroughly explained in previous chapters by means of Qanats maps. Since many wells have dried out and several Qanats paths have been destroyed by urban projects, this facility is no more easily available for the gardeners or farmers. This criterion is connected to economic criterion of 'financial situation of the owner' and imposes more expenses for the owner to keep the green parcel. There are mainly three reasons that the Qanats have been destroyed in the last decade in Tehran; high rises with deep cellars or parking spaces, the west-east planned expansion of Tehran which disconnects their paths vertically and the new Niayesh tunnel which has been finished in 2012. This tunnel with total length of 10252 meter connects east traffic to west in the north of Tehran and according to the interviews[1] has cut the north-south Qanats. This project can be a clear example of the weak pre-ecological assessment of the urban projects which is extremely strong in a country like Germany (chapter 4). Since ecology is a cycle, with deleting one element, the whole dependant elements will not be able to function properly.

Air pollution is another element which has damaged the function of this cycle and is itself the consequence of the damaged ecological system (Chapter 5). The gardeners claim that their agricultural products do not have the same quality they had years before. The toxic air pollution indexes have ruined the quality of the fruits and vegetables and this decreased the dealing price once again and discouraged the owner to keep the green land. Moreover, due to the improper separation of sewage and clean water in the rivers heading the south of Tehran, many of the farmlands are being irrigated with the contaminated water. This ruins the ecological cycle, agricultural products and the indirect consequences affect the garden economy. At the end, it may change the whole spatial organization of the city, although the initiate problem has emanated from ecological factors. That is the reason that in this study the system thinking is dominant and the inter-relationships between all the aspects of the city have to be taken into consideration. Hence, it is emphasized that garden destruction is a multidimensional issue with its origins in all aspects of the city.

By considering the described factors in figure 6.20, the enhanced DPSIR network model of the research is produced as figure 6.24. The strong interdependencies between DPSIR elements have been shown with orange (one level gap between the elements) and the weaker ones (more than one level gap) with green. Note that there are more relationships between the criteria and sub-criteria in different levels. Figure 6.25 is the description of the elements of the DPSIR model.

[1] Dr.Mazaherian, Deputy of Housing and Urbanism, Road and Urbanism Organization
Ms. Yalda, Mesocity Workshop 2012

Green lands' Destruction in Tehran Model

Driving

Socio-cultural Factors

Fast Tehran/ population growth

Lack of people participation

Job and social level

Lack of belonging to region

Disappearing villa-dwelling life style

Economic-financial Factors

Financial problems

Municipality

Owner

Closed financial system

Tax system

Building Industry

Land speculation

Institutional- Juristical Factors

Commissions Code

5

7

100

Regulations

Article 14

269,329

Second council

Deprived plans

Ersatzflächenpool

Surveillance body

On municipality

On Commissions

Management body

Independent for green lands

Allocating gardens' responsibilities

Eco- Urban Factors

Technical urban system

Urban land use of gardens

Flexibility in detailed plans

Weak position of gardens in Master plan

No garden land sue in urban maps

No hierarchical preservation plans

Unclear urban ecological data

Ecological characteristics

Insufficient water resources

Ruined agricultural products

Legal urban

High- rises

Ownership

Garden with no land use

Fragmented / connected gardens

Pressures

Green lands destruction

Loss of balance between built environment and urban ecology

State

Climate Change

Air pollution

Lack of open space

Unplanned urban spatial organization

Unsustainable urban development

Impact

Quality of life

Environmental impacts

Quality of agricultural products

Air pollution

Response

Policy making

Regulations

To preserve green lands in Tehran

Figure 6.24: The enhanced DPSIR network model of the research with the inter-relationships

Figure 6.25: The description of the criteria combined with the elements of the enhanced DPSIR network model of the research

Element of DPSIR	Factor	Related Criteria	Explanation/ Sub-criteria
Driver	Socio-economic	Fast and unplanned Tehran growth	This led to introducing the suburban gardens in to the city therefore the need for living/ work spaces increased. At the same time a city without an urban plan expanded unorganized.
Driver		Population growth	Because of the high request for work and living space, new activity centers started to grow in the north in contrary to the new Master plan.
Driver		Job and social level	There is always a wealthy buyer but the owner can be wealthy or not so, depending on his socio-economic level.
Driver		Lack of belonging to the region	Because of Tehran changes explained above there are plenty of immigrants, non-native and new rich people who do not give the same value to gardens as previous local residents.
Driver		Generation change of the owners	Gardens are the heritages from parents. The children do not follow the same life style and cannot find the compromise to divide a big parcel legally among themselves.
Driver		Lack of people participation	Lack of NGOs, people surveillance on urban management and a survey mechanism conducted by citizens for big urban projects
Driver	Economic-financial	Financial issues of the municipality	Yield large revenue from selling building density and land use conversion. The municipality does not use his properties.
Driver		Financial issues of the owners	Economic expenses of keeping a garden cannot be justified.
Driver		Construction industry as the main national industry	Building industry thrives when high-rises are built. Therefore this id one of the engines of the national industry.
Driver		Land speculation	The difference between the land price and the apartments built on that plot is so high that it encourages every owner to construct. The garden parcel does not have an added value.
Driver		Lack of a closed system for financial tasks of gardens	Working with TDR becomes harder with the system which is open for many organizations to benefit from.
Driver		Lack of organized tax system	The tax system in different social level's incomes does not present social justice of Tehran. Moreover, The high-rises take the light, air and privacy of the gardens without paying any tax.
Driver	Institutional- juristical	Commission Code 5	With unclear function and unlimited power this commission has converted many green to non-green land uses. There is no surveillance on its functions. Paragraph 269 and 329 are the outcomes of it as well.
Driver		Paragraph 269 and 329	Everyone can get the permission for 4-5 floors apartment in Tehran.
Driver		Commission Code 100	There is no surveillance on this commission and it is not implemented as it is supposed to be.
Driver		Article 14 of Urban Land Regulation	There is no guarantee that with participation of municipality in gardens, his share will be preserved.
Driver		Commission Code 7	In appropriate definition for garden in law
Driver		Lack of Ersatzflaechenpool	No system which tries to keep the balance between constructions and green fields in the city.

Figure 6.25: The description of the criteria combined with the elements of the enhanced DPSIR network model of the research (Continued)

Driver		Lack of written law allocated to gardens	There should be a set of new regulations for gardens with taking new circumstances into consideration.
Driver		Lack of an independent garden organization	There should be an independent organization for gardens which has nothing to do with municipality
Driver		Allocating garden responsibilities	Surveillance, juristical, financial and implementation tasks of the gardens should be clearly allocated to different sections.
Driver		Lack of surveillance on municipality	City Council or City commission is not accomplishing his task of surveillance on municipality properly.
Driver		Lack of incentive policies	More incentive and deprived regulations should replace the current preventative ones.
Driver	**Eco- urban**	The weak position of gardens in the Master plan zoning	There is not a unique layer for gardens in the Master plan.
Driver		Flexibility in the detailed plans	In a city with such huge issues and the lack of green space, there should not be a possibility for the owners to choose from a series of land uses in the detailed plans because normally green space with little profit will not be chosen.
Driver		Permission for high-rises	Many times constructing high rises has been prohibited in Tehran but never last for a long time.
Driver		Parcels with no land use	Before the Master and detailed plans, these parcels were a part of urban maps and usually converted to non-green land uses.
Driver		Ownership	Private and public ownership both enter the destruction circle but with different approaches, speeds and ways.
Driver		Parcel form	The fragmented and small parcels are easily destroyed.
Driver		Lack of "garden" land use in urban maps.	There should be an ecological network of Tehran which generates the garden parcels.
Driver		Poor quality of agricultural products	Air pollution has negative impact on the quality and quantity of agricultural products.
Driver		Insufficient water resources	The non-technical urban plans have destroyed the qanats system.
Driver		Lack of hierarchical preservation plans	There should be preservation plans in different urban scales according to the size of green space for preservation.
Pressure	The loss of balance in the city	The loss of balance between green and built land	Using the land more than its natural capacity and locating 8 million people in a city with not enough water supplies, green space, fresh air and road network is a huge pressure on the earth and the people living on it. As shown in chapter 2 in system resilience of Chen, Tehran is reaching the threshold point and the moment it reaches there, the maximum pressure on the earth will occur, then, the recovery phase is again another pressure for the residents.
Pressure / State	Green lands' destruction	The area of the Greenland disappeared in Tehran from 1955	In chapter 5 it has been proved that there is a decreasing procedure in green lands' area of Tehran. This ongoing process can be considered both as a pressure and a state.
State	Climate change	Iran and Tehran climate change factors	According to CCPI (chapter 3) in 2013 among 61 countries, Iran has the 60th rank concerning climate change performance index. In Tehran, the increase in daily temperature and humidity, the high air pollution indexes which affects quality of life shows the alarming status of climate change in this city.

Figure 6.25: The description of the criteria combined with the elements of the enhanced DPSIR network model of the research (Continued)

State	Air pollution	High pollution indexes compared to global standards	CO, CO_2 and Pm_{10} are in some days of the year 3- 4 times more than Standards.The World Bank estimates losses inflicted on Iran's economy as a result of deaths caused by air pollution at $640 million, which is equal to 5.1 trillion rials or 0.57 percent of GDP.
State	Health problems	Rate of people dying because of air pollution	It is estimated that about 27 people die each day from pollution-related diseases. According to local officials, 3,600 people died in a single month due to the hazardous air quality. The relationship between mortality and air pollution in Tehran has been shown with spatial maps in chapter 3.
State	Lack of open green space	The low rate of green space in Tehran	According to the Master Plan just 11% of the whole city is green space. Note, any green barrier of highways and hedges which separate the buildings from the streets are inclusive.
State	Unplanned spatial organization	Few urban plans before 2006	Expansion of Tehran was often according to couple of legal enacted paragraphs and based on the mayor decisions before 2006.
State	Unsustainable urban development	Socio- cultural, economic, institutional and environmental dimensions of sustainable development.	Different dimensions of sustainable development have been explained and examined in Tehran as the fundamental base of the research and there are weak signs of sustainability in any aspect of the city.
Impact	Environmental impacts	Soil degradation, inadequate supplies of potable water; water contamination from raw sewage and industrial waste.	A report by the United Nations Environment Programme ranked Iran at 117th place among 133 countries in terms of environmental indexes. Iran ranked worst in the world for soil erosion in 2011. The destruction of natural Qanats system and as consequence losing the gardens which are dependant to them is another disappointing impact.
Impact	Quality of agricultural products	Increase in temperature, water shortages, air particles/dust on leaves	70% of the leaves of the trees close to highway shoulders in Tehran are almost drying out because of the air pollution. They have transformed from flat shape to needle like because they cannot filter the polluted air. On the other side, the quality of agricultural products has significantly decreased because of the high air pollution.
Impact	Quality of life	international development, healthcare and employment	According to a survey Iran rank is 94 out of 95 countries. Tehran status in chapter 3.
Response	Policy making and regulations to preserve gardens and agricultural lands	Quality and Quantity plans, regulations and action plans	Set policies for each set of effective factors in destruction of the gardens according to the region and its characteristics. Set hierarchies and priorities according to previous studies from 1955, literature review and international case studies.

Source: The author

6.5 Methodology

Regarding the derived criteria it is apparent that the type of data and variables in the whole research cannot be summarized in an objective way. This problem stems from the fact that in Iran, it is impossible to get access to the data of different times and of different official organizations that are both reliable and comparable. Working with substitute data and uncertainty ruins the scientific character the author tries to pursue. Thus a subjective method has to be followed, i.e. a method based on experts' ideas and knowledge. In the first chapters, however, objective methods have been applied to discuss different socio- economic, legal, juridical, urban and ecological subjects. Nevertheless, the subjective method explained here will eventually be applied to combine the outcomes from different fields and come to final decisions.

As explained before, Factor analysis has been one of the methods considered to be the methodology in this research. "Factor analysis is a statistical method used to find a small set of unobserved variables (also called latent variables, or factors) which can account for the covariance among a larger set of observed variables also called manifest variables"(Spearman, 1904 quoted after Albright and Park, 2009, p.2). "The assumption of factor analysis is that underlying dimensions (factors) can be used to explain complex phenomena. Observed correlations between variables result from their sharing of factors. A major goal of factor analysis is to represent relationships among sets of variables parsimoniously yet keeping factors meaningful.

Factor analysis is commonly used in data reduction, scale development, the evaluation of the psychometric quality of a measure, and the assessment of the dimensionality of a set of variables." (Khelifa, 2005)

The first usage of this method in the above list was considered for the study. From this angle, factor analysis is viewed as a data-reduction technique as it reduces a large number of overlapping variables to a smaller set of factors that reflects, constructs or differentiates the dimensions of constructs. There are two main types of factor analysis, the Exploratory and the Confirmatory one.

"Investigators wish to explore patterns in the data or to test explicitly stated hypotheses. Exploratory factor analysis (EFA), corresponding to the former task, imposes no substantive constraints on the data; there is no restrictions on the pattern of relationships between observed and latent variables. EFA is data driven" (Brown 2006, p.14 quoted after Albright and Park, 2009, p.2). "Each common factor is assumed to affect every observed variable and that the common factors are either all correlated or uncorrelated. Once model is estimated, factor scores, proxies of latent variables, are calculated and used for follow-up analysis. General purpose statistical software packages such as SPSS, SAS, and Stata can perform EFA. This kind of Factor analysis has been supposed to be implemented in this research.

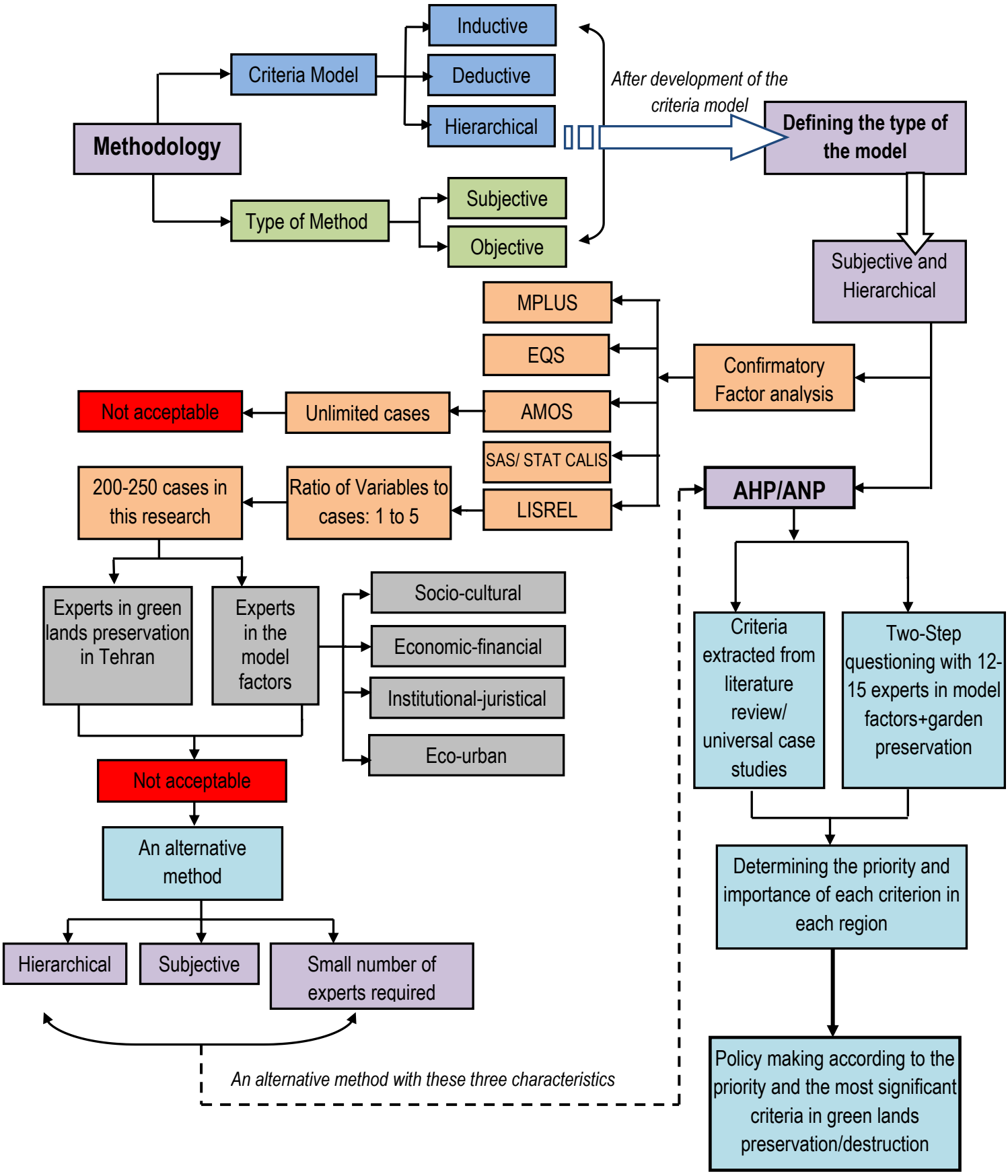
Confirmatory factor analysis (CFA), on the other hand, is theory- or hypothesis driven. CFA allows substantively meaningful constraints to be placed on the factor model. Researchers can specify the number of factors or set the effect of one latent variable on observed variables to particular values. CFA allows researchers to test hypotheses on a particular factor structure (e.g., factor loading between the first factor and first observed variable is zero). Unlike EFA, CFA produces many goodness-of-fit measures to evaluate the model but do not calculate factor scores. CFA requires special purpose software packages such as Mplus, LISREL, Amos, EQS, and SAS/STAT CALIS" (Albright and Park, 2009, p.2-3).

Using CFA and SPSS tool as a method to summarize the criteria and to reduce the huge data collected in the first chapters seems logical but as stated in chapter 1, the exact methodology can be confined after the development of the research and extracting the criteria which are now in the model illustrated in figure 6.20. Based on SPSS theoretical basis and after consulting experts in this field[1], it became clear that SPSS cannot be applied for the derived criteria and the final model. As the criteria were not clear in the beginning, their interrelationships and the whole model based on them could not be clarified. Therefore, using Factor analysis

[1] Dr. Zebardast (university of Tehran), Dr. Dezfooli (The Information Organization of Tehran municipality)

with the SPSS tool was one of the first initial assumptions and in this part the final suitable methodology will be specified.

Figure 6.26: Methodology procedure, choosing the best methods according the Criteria Model



Basically, there are three types of research models formed on the research criteria: Inductive, deductive and hierarchical. The designed model in this research is hierarchical and can be adjusted into Confirmatory Factor Analysis. There can be two software packages suitable for the study and it characteristics: Lisrel and Amos. In Amos unlimited numbers of cases have to be entered and therefore cannot be applied in this research whereas in Liserel usually the ratio of variables to cases has to be 1 to 5 which in this research counts up to more than 300 cases (there are 62 criteria and sub-criteria). The combination of a subjective method and Confirmatory Factor analysis leads to the necessity of more than 300 questionnaires. This could have been conducted if the respondents were normal people in the society but in the case of the illustrated model the suitable methodology can be implemented when more than 300 questionnaires have been filled out by professionals in all criteria/factors concerning the four dimensions (socio-cultural, economic-financial, Institutional- juridical and eco-urban criteria) and also they have to be experts in garden preservation in Tehran. This cannot be a realistic methodology which ends to the logical answers that this number of experts cannot be found in the Tehran urbanism system and educational society.

The alternative method considered in chapter 1 for the research was AHP[1]/ANP[2] which has to be examined here to confirm its usage for the derived criteria and the designed model. Considering the final hierarchical model in figure 6.20 the best methodology can be AHP or ANP. Figure 6.26 describes the methodology process, the procedure that AHP has been selected as the suitable method for the research. According to AHP literature review on these two methods, 12 to 15 experts are enough to be interviewed. This number of respondents could be found in Tehran. The methodology is based on AHP combined with 2-phases questionnaires. The very first designed model is shown in black frames in figure 6.20 which is the summary of all the variables extracted from the research studies. These criteria are the outcomes which the author obtained at the end of the first five chapters and by the literature review. The other criteria with red color frames are the ones which have been added by the experts during the interviews or by questionnaires, and the combination of both criteria made the complete AHP or Criteria model.

The questionnaires consist of two phases. In the first phase the reliability of the model has been examined and thereafter the model has been completed by the criteria added by the experts. In the second phase the model has been controlled and the priorities, the level of effectiveness and importance of the criteria and factors have been submitted. This means that in the first phase the author will show her model to the experts and ask if they accept this model and that these criteria have influenced the green lands' destruction in Tehran, and if not, what changes can be appropriate. In the second phase the author will ask about the impacts of each criterion on green land's destruction and how and why it is taking place. So it will be focused more on the destruction process and the relating discussions.

6.5.1 Utilizing AHP/ ANP in the methodology

Analytic hierarchy process (AHP) is a methodological approach which implies structuring criteria of multiple options into a system hierarchy, including relative values of all criteria, comparing alternatives for each particular criterion and defining average importance of alternatives. In that way a basis is created to make appropriate decisions. AHP is a structured technique which is used in complex decision-making. The goal is to single out and offer one out of several possible decisions. While doing so one does not insist on exclusively «correct» decision, but by this method that the decision is chosen that proves to be the most adequate or the most useful one. AHP method offers a meaningful and rational framework for structuring problems and presenting and quantifying the elements that cause the problem. Techniques of putting together these elements and techniques of evaluating alternative solutions is a path to a final solution (Pogarcic et al., 2008, p.3).

[1] Analytic Hierarchy Process
[2] Analytic Network Process

"The seven pillars of the Analytic Hierarchy Process (AHP) serve as a starting point for the Analytic Network Process (ANP).The ANP provides a general framework to deal with decisions without making assumptions about the independence of higher level elements from lower level elements and about the independence of the elements within a level. In fact the ANP uses a network without the need to specify levels as in a hierarchy. Influence is a central concept in the ANP. The ANP is a useful tool for prediction and for presenting a variety of competitors with their surmised interactions and their relative strengths to wield influence in making a decision.

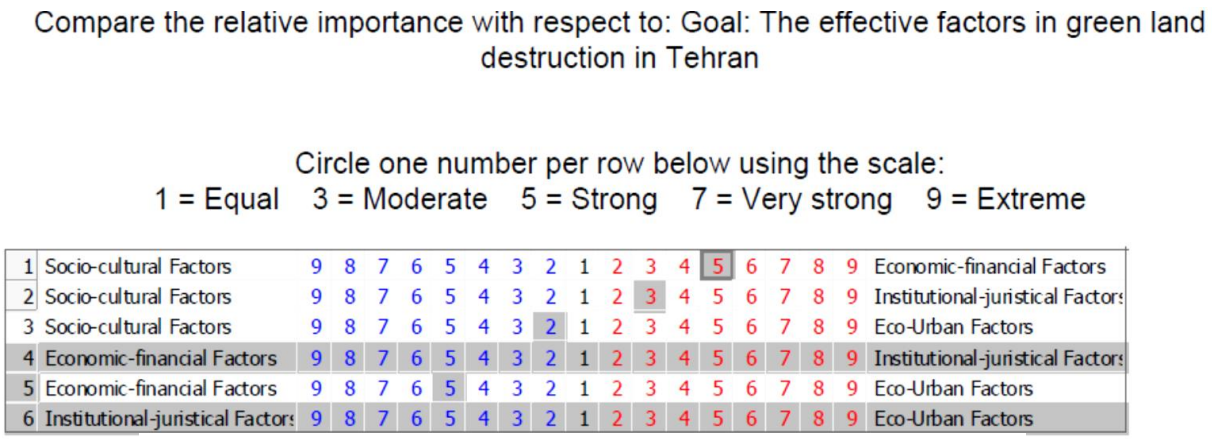
The ANP is coupling. The first consists of a control hierarchy or a network of criteria and sub-criteria that control the interactions. The second is a network of influences among the elements and clusters. The network varies from criterion to criterion and a different super-matrix of limiting influences is computed for each control criterion. Finally, each of these super-matrices is weighted by the priority of its control criterion and the results are synthesized through addition for all control criteria" (Saaty, 1999, p.1).

Due to the complexity of the designed hierarchical model of the research and the existence of several sub-criteria, using a simple methodology will be more appropriate. AHP is a simple tool and its results are not very different from ANP. The criteria and sub-criteria have been entered into "Expert Choice" software and have been weighted according to the questionnaires and the author's interviews and research. Afterwards, the pair-wise comparisons based on Saaty scale shown in figure 6.27 have been implemented. These comparisons have been conducted as follows: the relative importance of the main criteria which are the factors in AHP model in respect to the main goal which is to find the most effective factors in the green land destruction; the second comparison determines the relative importance of sub-criteria to the main criteria of the category they belong to; and at the third level the relative importance will be compared in respect to the higher level data until all the sub-criteria have been weighted. Figure 6.28 shows an example of the pair-wise comparisons between the main criteria in Expert Choice. This is the base of the questionnaires as well.

Figure 6.27: Scale of Relative Importance for pair wise comparison in AHP presented by Saaty

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Somewhat more important	Experience and judgement slightly favour one over the other.
5	Much more important	Experience and judgement strongly favour one over the other.
7	Very much more important	Experience and judgement very strongly favour one over the other. Its importance is demonstrated in practice.
9	Absolutely more important.	The evidence favouring one over the other is of the highest possible validity.
2,4,6,8	Intermediate values	When compromise is needed

Figure 6.28: The pair-wise comparisons of the AHP model in the Expert Choice software (Questionnaires)



Source: Author using the AHP model in the Expert Choice software

By synthesizing all the weights, Expert Choice presented figures 6.29 to 6.34. Figure 6.29 shows the relative importance of the main factors to each other and figures 30-33 show the weights of importance of the sub-criteria in respect to each of the four main factors. The final figure 6.34 shows the final weights of all sub-criteria in all groups in respect to the goal. In better words, this figure shows how much each criteria has been effective in destruction of the green lands is Tehran[1].

Figure 6.29: The final weights of the main criteria in the research AHP model

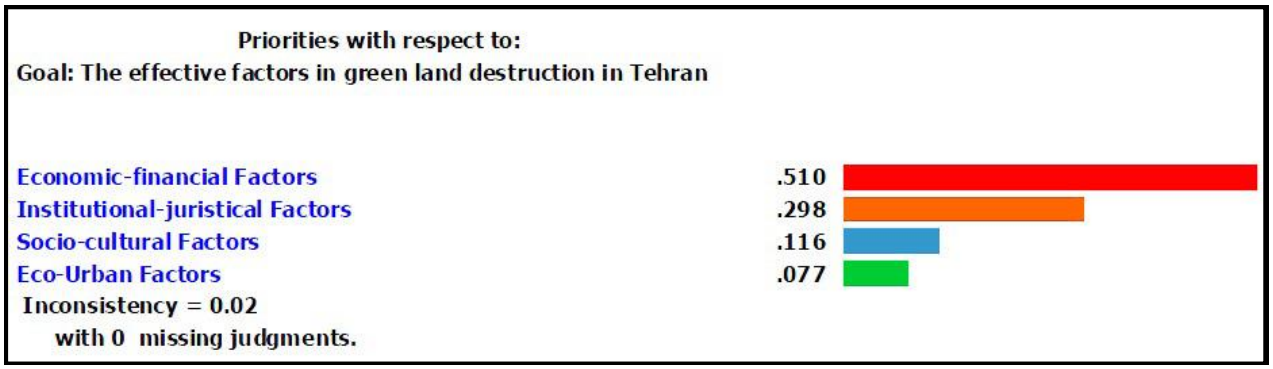


Figure 6.30: The final weights of the sub-criteria in socio-cultural factors in the research AHP model

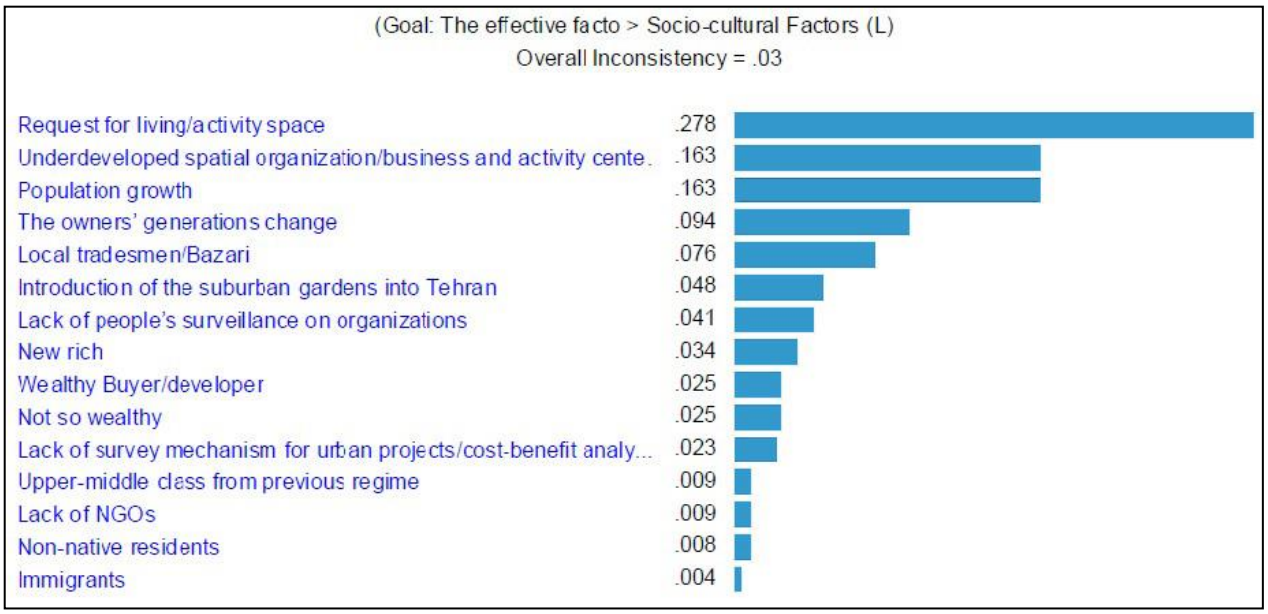
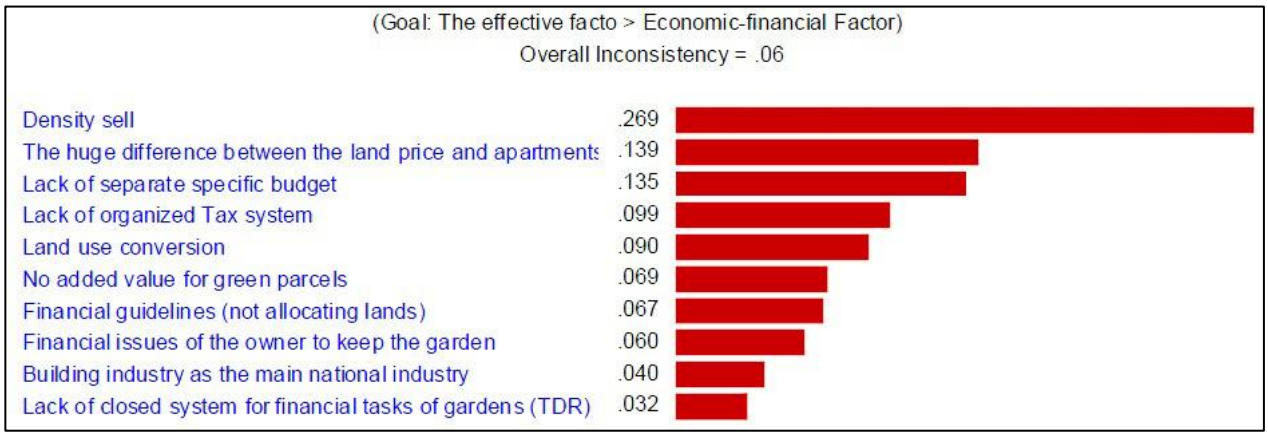


Figure 6.31: The final weights of the sub-criteria in economic-financial factors in the research AHP model



[1] All the figures of this part have been designed by the author in the Expert Choice using the data from the AHP model.

Figure 6.32: The final weights of the sub-criteria in institutional-juristical factors in the research AHP model

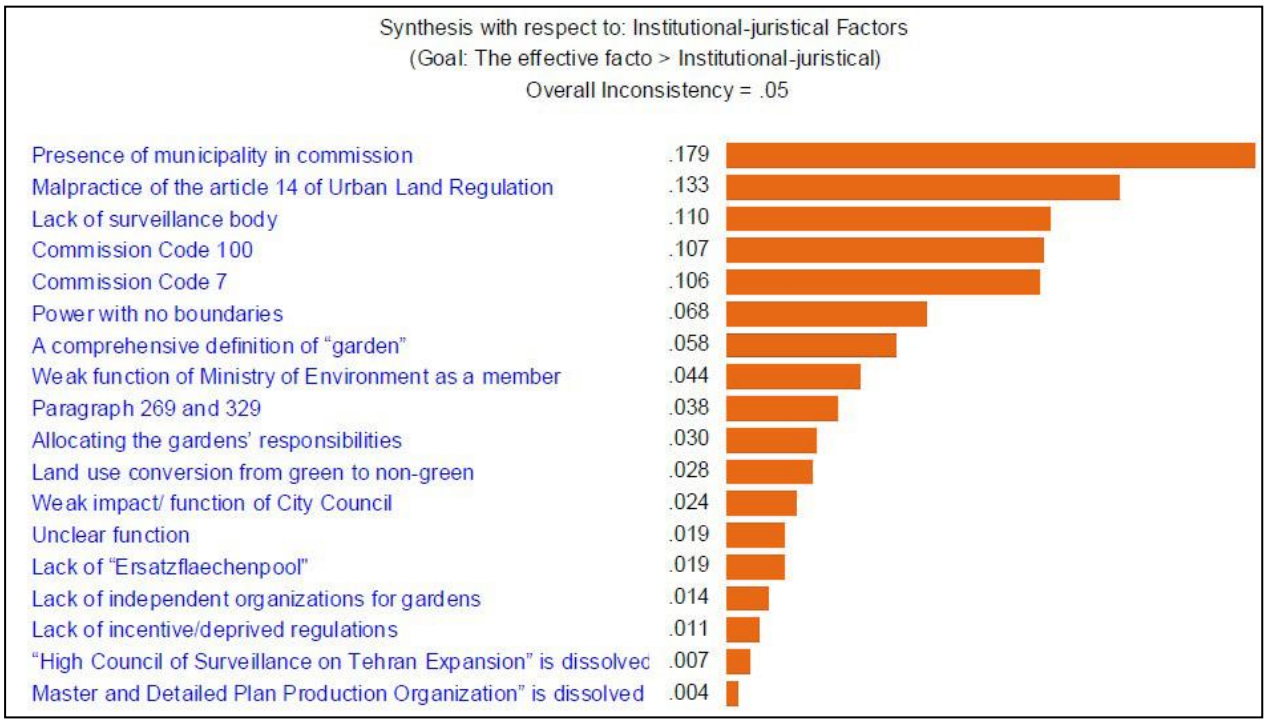


Figure 6.33: The final weights of the sub-criteria in eco-urban factors in the research AHP model

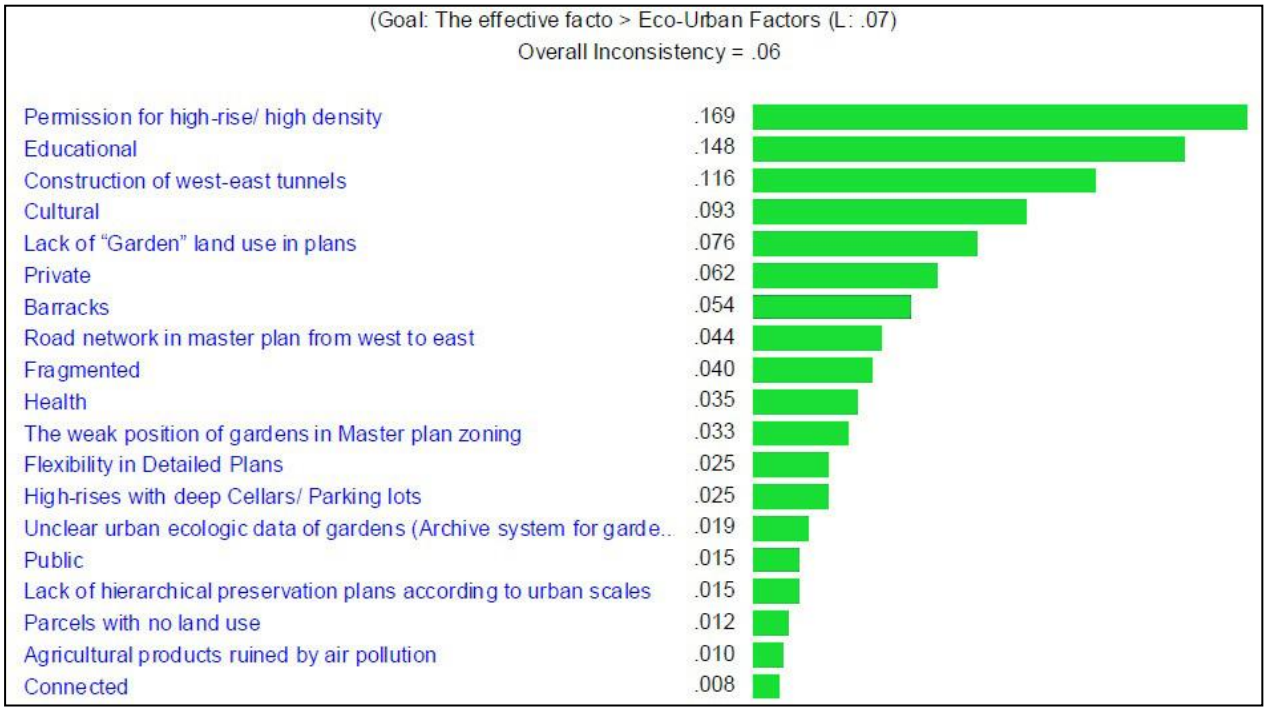


Figure 6.34: The final weights of all the sub-criteria of the four factors in the research AHP model

6.6 Conclusions

In this chapter the DPSIR model has been selected as the suitable tool to summarize and organize the extensive data gathered in the first four chapters. By adjusting research elements of the first chapter on DPSIR model, the interrelationships have been thoroughly explained. In the next step, the criteria derived from the whole research, questionnaires with experts and the case study comparisons have been presented as a hierarchical model based on the theoretical thesis of the research, sustainable development dimensions. The four dimensions of sustainable development have been combined and altered to match the discussions in the first chapters and to show the characteristics of this study. This model has been combined with DPSIR model and each element has been explained in a table. Based on the hierarchical model and the type of the gathered data, AHP has been chosen as the best tool to complete the methodology. By using the Expert Choice software, the final weight of each criteria and sub-criteria has been determined. This shows the importance and the effect each has on the green land destruction in Tehran.

According to the final results of AHP model in the Expert Choice (Figure 6.29), economic-financial factors are the most effective reasons of garden destruction followed by institutional-jusritical factors, socio-cultural and at the end eco-urban ones. This shows how important economic issues can be in urban system that they have the most crucial impacts on ecological phenomena. The regulations and organization structures have to be altered in the second step to stop the current destruction process. It is interesting to know that social and cultural factors play a more important role in garden destruction than urban and ecological factors. The necessity of considering green land destruction issue as a multi-dimensional problem in an urban system can be better perceived and confirmed here. Since the most important reasons of losing the gardens and farmlands stem from other aspects of the city than ecological.

The most effective criterion has been generated as selling density (figure 6.34) which is in relationship with the three next criteria: The lack of separate budget for the municipality (Forth criteria) makes him sell density and be an active member of Commission Code 5 (Second criteria) and the whole economic system moves towards a enormous profits in the construction business (Third criteria).

The majority of the next criteria comprise legal items, the weaknesses in regulations which start from Article 14 (chapter 4) and goes to the commissions and municipality structure. Three policies which relate municipality come in the next importance order: land use conversions as revenue which has been described by statistics in this chapter; the fact that the municipality avoids the policy of using his properties and assets in losing the urban problems; and the last policy which is a legal problem comprises the fact that there is no added value for owning a garden and in most cases it imposes many extra costs and complications to the owner. Thus, “financial issues of the owner to keep the garden” comes as the 14th criteria just after the request for living space. This result shows a relative consistency between the final weights, since the criteria which are more connected to each other get the near rankings too.

Commission code 5 with an extensive power stands as 15th criterion which requires a modification in the limits of the decisions taken by this commission. Among 62 criteria effective in green land destruction, the necessity of a new definition for garden which covers all the legal problems of preservation has the 16th place which shows its importance. The criteria mentioned above were mainly the ones related to economic or legislative structure of the city and can be altered by re-planning, reorganizing and setting policies. However, many others which come in the next rankings are not easy to change. For instance, the 17th criterion which emphasizes on the importance of the building industry in Iran and its relation to garden destruction is on the national scale. A feasible strategy may not be able to cover this level of change at least in a short time. On the 19th rank is a criterion which cannot be changed in the present time but can be improved in future: permission for high-rises; the high buildings which have been allowed and thereafter destroyed the gardens cannot be demolished but through appropriate strategies these constructions can be prohibited. In the middle, 18th rank criterion focuses on the functions of the Ministry of Environment in Commission Code 5. The modification in the management structures is the content of the majority of the first 20 criteria. Once more, two criteria which are firmly connected to each other stand on 20th

and 21st position; population growth and as the result underdeveloped spatial organization of the city in that period of time. This confirms the reliability of the model and its close connection to the reality.

The majority of criteria between 20th and 40th rank are concentrated on urban factors and then Institutional-juristical ones. Whereas, the last 15 criteria, from 47th to 62nd comprise principally socio-cultural factors and then eco-urban ones. In general, the results show that the criteria which can be altered, modified and improved intensify chiefly in the first positions and are the most significant reasons of green land destructions. Since the research tries to be realistic and give feasible strategies, this fact eases the policy making for the next chapter.

The criteria such as changing or shifting the social levels, building construction as the main productive national industry, prohibiting immigrants to Tehran and population growth are fundamental, national and very complicated to be solved by one single research on green lands destruction. As a result, the strategies will not work on them as the main goals but rather a long-term national approach in all urban system elements. The second type of criteria contains the ones which cannot be changed in the present time because they have their essence from the past but can be improved for the future. This group compared to the first one can easier be altered. The constructed high-rises, the west-east city expansion, the qanats which have been destroyed by the new tunnels or city developments have all happened in the past and their existence cannot be omitted from the reality but their consequences and repeatability can be prevented. Apart from these two main groups, the rest of the criteria are easier in the hands of the planner for any modification, adjustment, amendment or development. However, among the third group different categories according to the easement of modification may exist. In the next chapter the criteria will enter the strategies based on their priority derived from AHP/Expert Choice results. The goal is to use the most effective criteria which are the results of theoretical framework, Tehran characteristics, historical documents, aerial photos, socio-economic studies, regulations and rules, case study comparison and the combination of all in AHP model so that the past failures will be less or not repeated.

7 Policy making in the field of green lands' preservation

In this chapter by using the results of the AHP model, the debates of the previous chapters, the conclusions of the world successful preservation examples, the overview on the legal and urban management structure of Iran and by considering the research problem from different aspects of sustainable development the preservation policies for each region and each category of green land (Chapter 5) will be presented. First of all, the consequences of implementing the legal urban plans will be reviewed to highlight the necessity of new acts and regulations or the amendments in the present ones.

7.1 Overlaying the 10 green land categories on the latest Detailed plans

In order to follow the upper-hand urban plans which have been approved in the High Council of Architecture and Urban Development of Iran, in this section the suggested zones of the Detailed plan have been overlaid in each region by the defined categories of chapter 6. Figures 7.1-7.9 show some parts of the big contradictions between the suggestions of these legal plans and the status quo land cover in case study regions which confirms that plans are not based on the ecological qualifications of the earth. In addition, unlike to Germany, there is no environmental assessment[1] of the plans required to approve each urban plan. Consequently, the environmental aspects of the plans have a very unsteady poor function. As can be perceived in figure 7.1, many of the green lands distinguished in the previous chapter have been covered by suggested non-green zones of the detailed plan which are R (residential), S (activity) and M (mixed). The upper map in figure 7.1 shows the exact type of green lands[2] which will be destroyed by implementing the detailed plan. Note that the building densities in each zone differ from low to high (fully explained in the tables of chapter 5) but in general they are not located in preservation zones and end up losing the green surface. In some cases even parks which have to be preserved in G111 zone have been neglected and covered by R zone.

The below map in figure 7.1 shows clearly in general what an enormous surface area of green lands the city will be lost when the Detailed plan is executed. Allocating residential zones to the residential-garden parcels can be accepted when there is an extra separated preservation plans for the trees inside the zones. As shown in figure 7.3 around 3,800,00 m^2 of lands in solely garden category will disappear by the Detailed plan in region 1. To give a better comparison view, these figures have been shown in regions 2 and 18 as well. In region 2 gardens and in region 18 farmlands are the most threatened green lands which will be ruined legally by the approved urban plans.

It has to be stated here that the statistics presented in the graphs are based on the "Select by location/are within the source layer" method in GIS software. In this method of choosing the parcels the parcels which are inside the suggested zones will be selected. Due to working with land cover and not land use in this study, some of the parcels may be not selected. This means that the numbers shown in the graphs are the minimum surface area of green lands which will be destroyed. As an instance, if the parcels have been selected by "intersect" method in GIS in region 1 the final surface area would have come to almost two times more than the one presented here. In this case, several parcels which have the main parts out of the zone may have been calculated. To avoid this, the minimum number seems to be more convincing. However, it cannot be certainly asserted that this entire surface will be lost in Tehran but it can be claimed that the way is much easier when the legal urban land use is Non-G zones. Since the land use parcels have not been the base of the categories in chapter 5 but rather the exact green surface in land cover, these statistics are the pure amount of trees/green surface being ruined and not the whole urban parcel. Obviously by taking into account the whole urban parcel shown in the legal plans the number would be even higher.

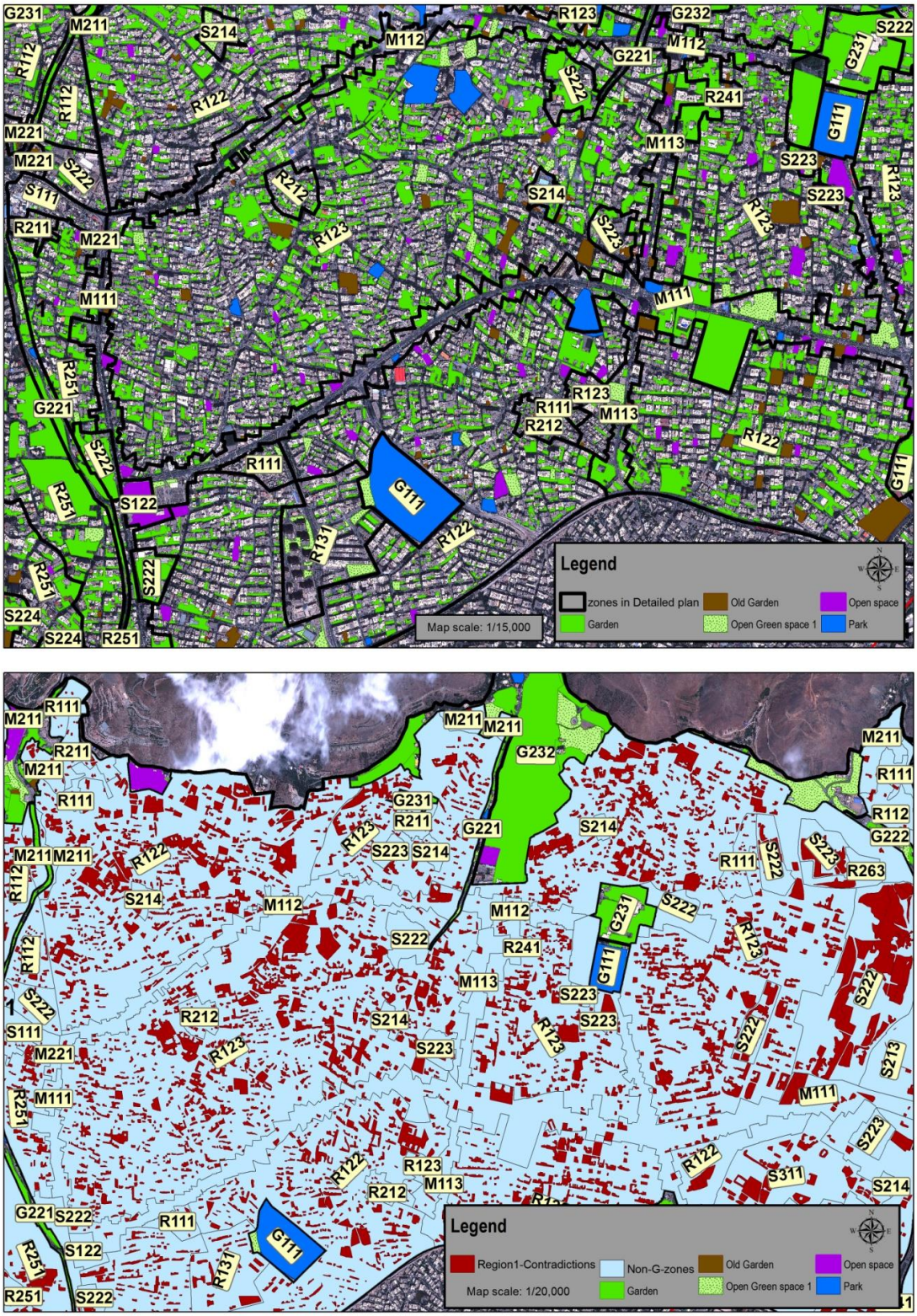
If the existing "garden and residential-garden" layer of the Detailed plan is taken into consideration, the gardens being destroyed after the proposed zonings according to its own legal definition of garden will be as figure 7.2.

[1] Umweltprüfung

[2] Including gardens, old gardens, open spaces, green open space 1 and parks which have been explained in chapter 5.

Thus, this figure does not take into consideration the green categories defined in this study. The second map shows all the green land uses of the Detailed plan which have been proposed to be covered by non-G zones.

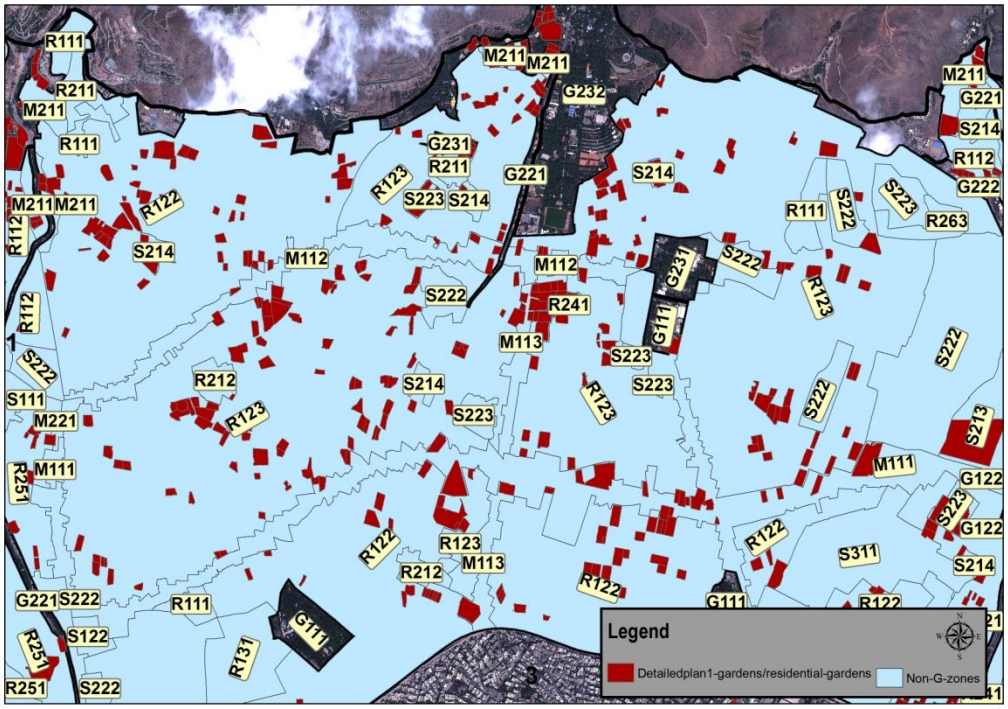
Figure 7.1: The contradictions between the green lands categories and the suggested zones of the region 1 Detailed plan



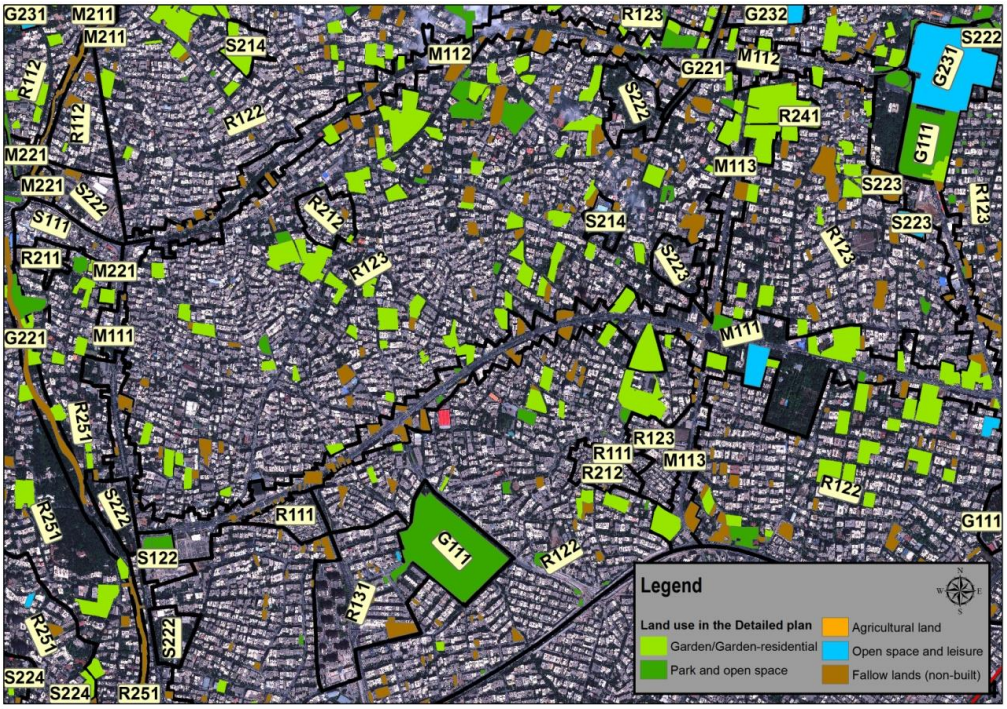
Source: The author using the data from Bafte-e-Shahr Consulting Company

Figure 7.2: The contradictions in the Detailed plan of region1 leading to green lands' destruction

Contradictions between the garden/ residential-garden in the status quo studies and the proposed zones in the Detailed plan



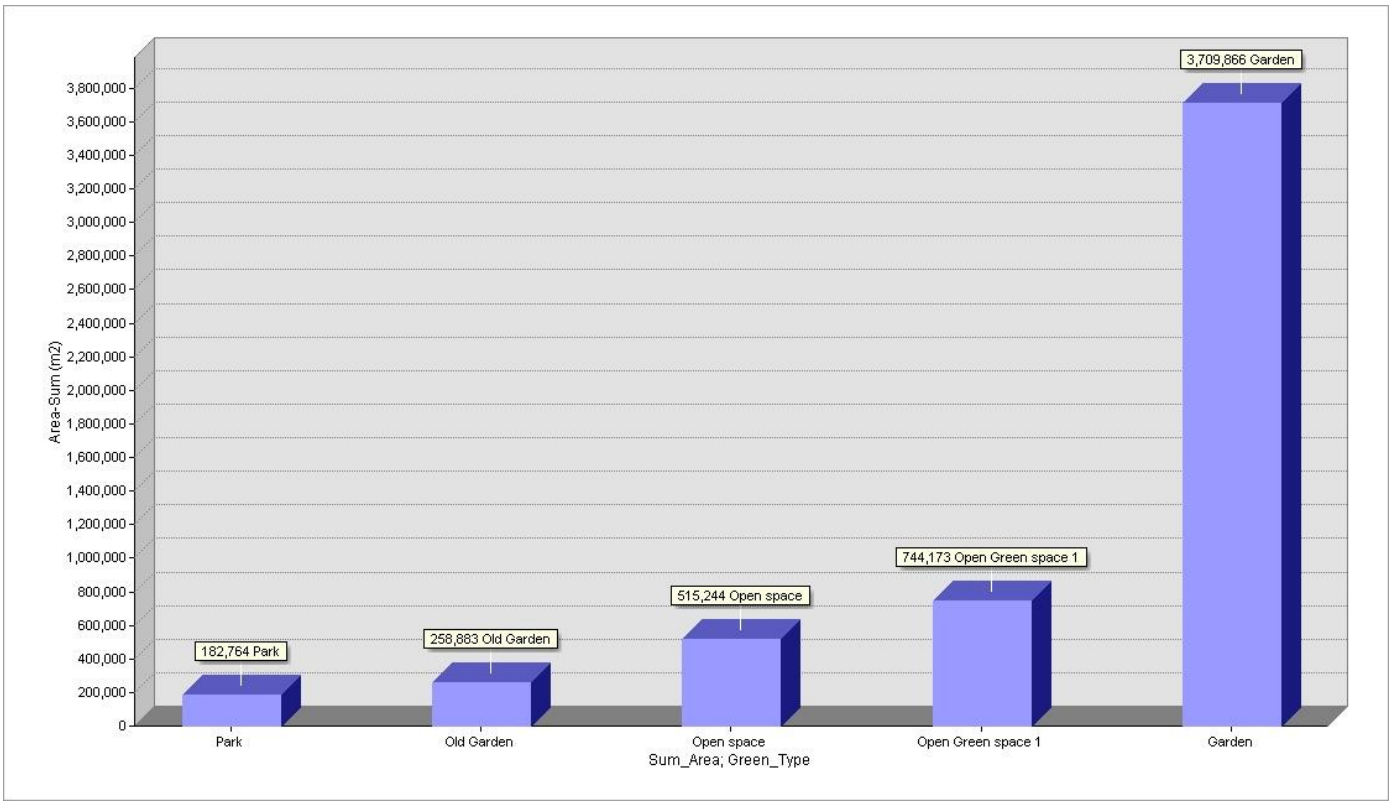
Contradictions between the green land uses in the status quo studies and the proposed zones in the Detailed plan



Source: The author using the data from Bafte-e-Shahr Consulting Company

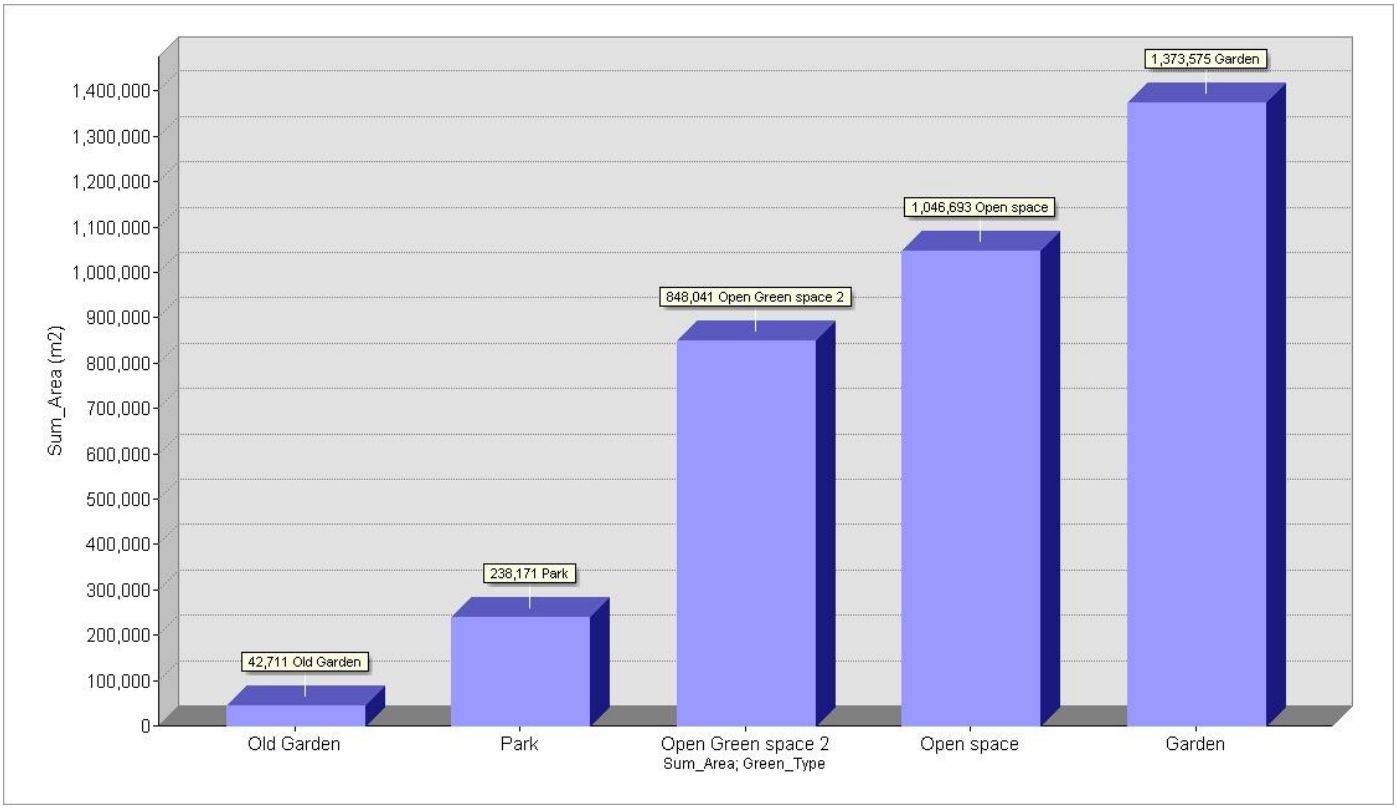
By using the same method in GIS for these green lands, 686 garden/residential-garden parcels out of 856 have been shown as the parcels which will be destroyed by implementing the proposed zones of the Detailed plan. This accounts to 2,008,290.1 m^2 of lands distinguished as garden in Iran law. According to figure 7.2 by taking into consideration the new category of garden in this research 3,709,966 $m^2$of gardens will be destroyed. In other words, 54% of the destroyed gardens shown in figure 7.3 are the gardens which are officially considered as garden in the Detailed plan.

Figure 7.3: The amount of the research green lands categories which can be destroyed by the suggested zones of the Detailed plan in region1



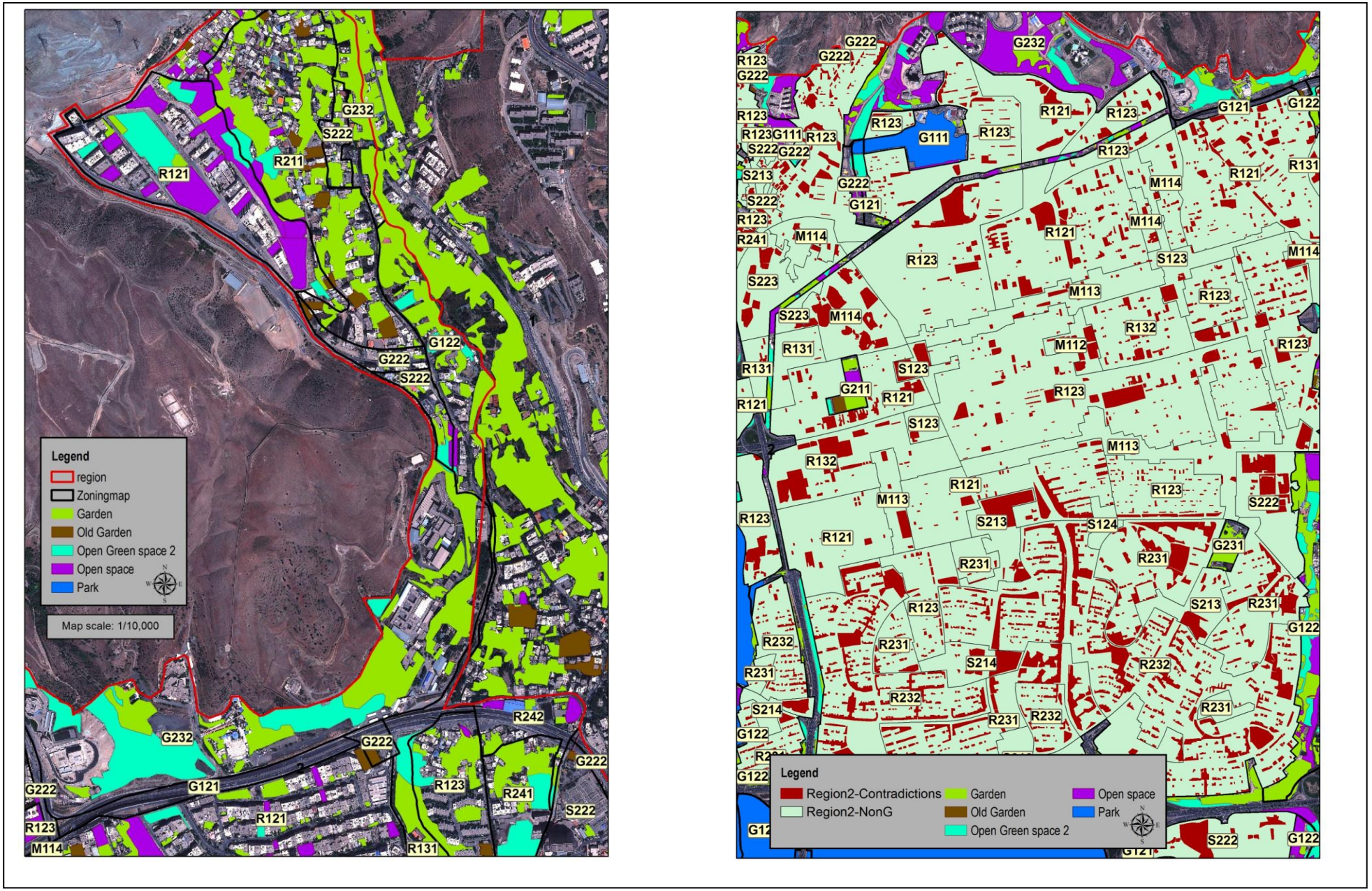
Source: The author

Figure 7.4: The amount of the research green lands categories which can be destroyed by the suggested zones of the Detailed plan in region 2



Source: The author

Figure 7.5: The contradictions between the research green lands categories and the suggested zones of the Detailed plan in region 2

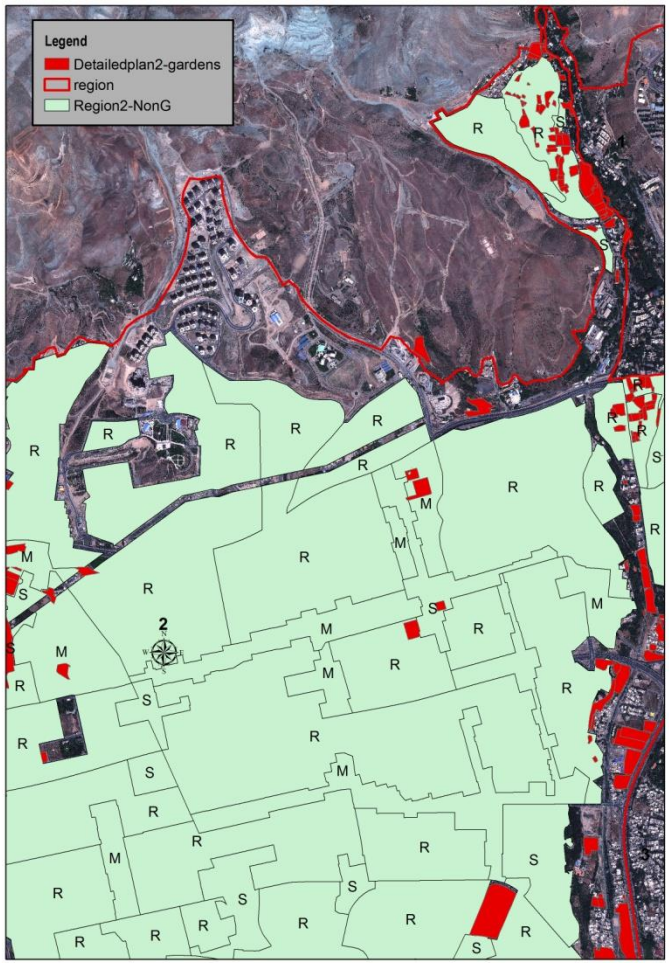


Source: The author using the data from Saravand Consulting Company

Region 2 Detailed plan has taken very few number of parcels into the category of gardens (figure 7.6). In addition, the layer of residential-gardens which was a positive step in region 1 has turned into garden-farmlands category which automatically ignore many of the green villas, especially in the northern half of this region. Thus, this category comprises a much smaller amount of green lands than the garden category defined in this research. Many of the garden parcels in this research have been signed as green and open space in the Detailed plan of region 2. By using the same method of selection in GIS, 139 out of 344 gardens will be covered by non-green zones.This amounts to 327,425 m^2 destroyed parcels which have been labeled as garden in the detailed plan status quo study. However, the destroyed garden category of this research has been calculated as 1,373,575 m^2. In other words, 23% of the destroyed gardens in this research are the official legal gardens in the Detailed plan.

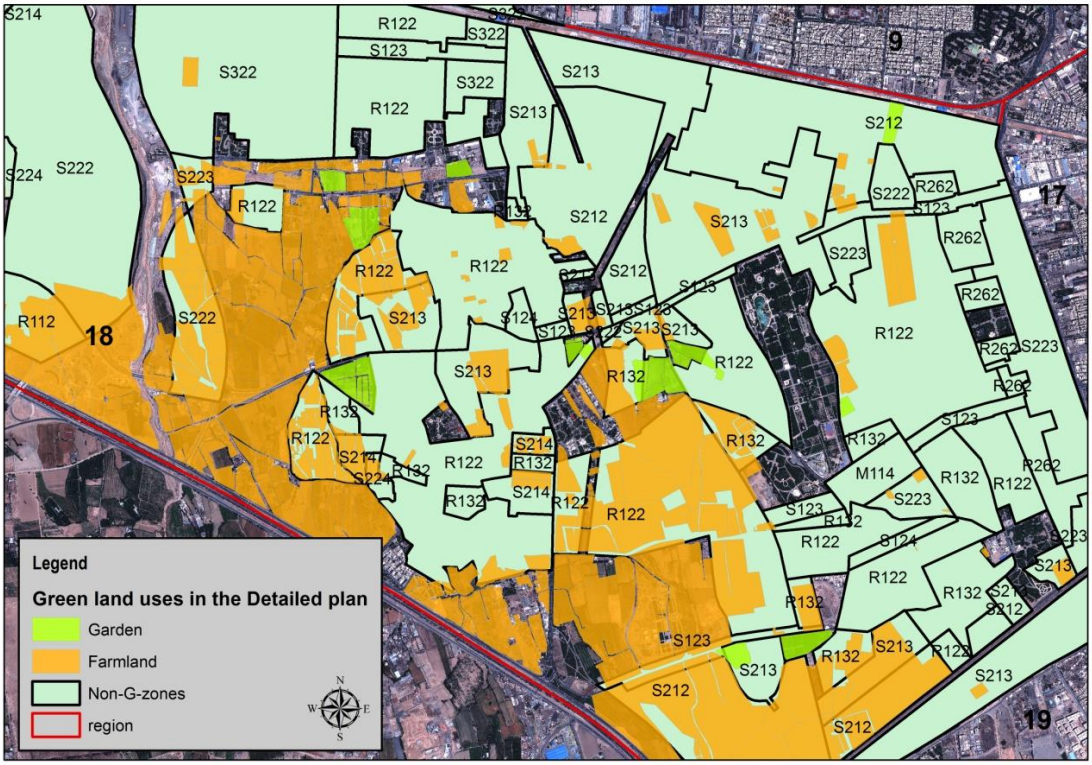
Since region 2 has big parcels of farmland, the contradictions inside the Detailed plan have been shown with a transparent map in figure 7.7 so that the boundaries of the propozed non-G zone and the aerial photo can better be observed.

Figure 7.6: Contradictions between region 2 Detailed plan status quo and the recommended zones leading to green destruction



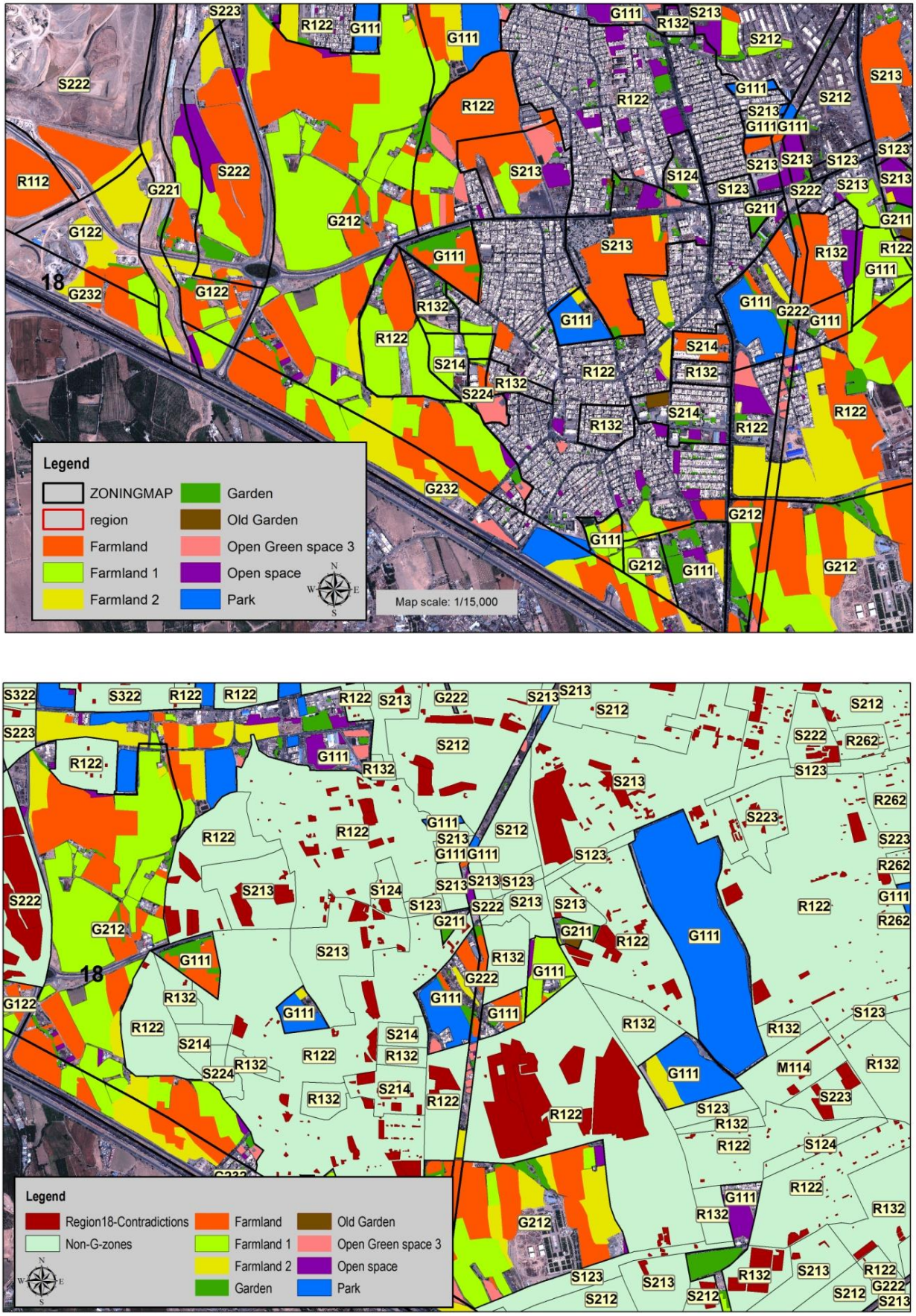
Source: The author using the data from Saravand Consulting Company

Figure 7.7: Contradictions between region 18 Detailed plan status quo and its recommended zones leading to green destruction



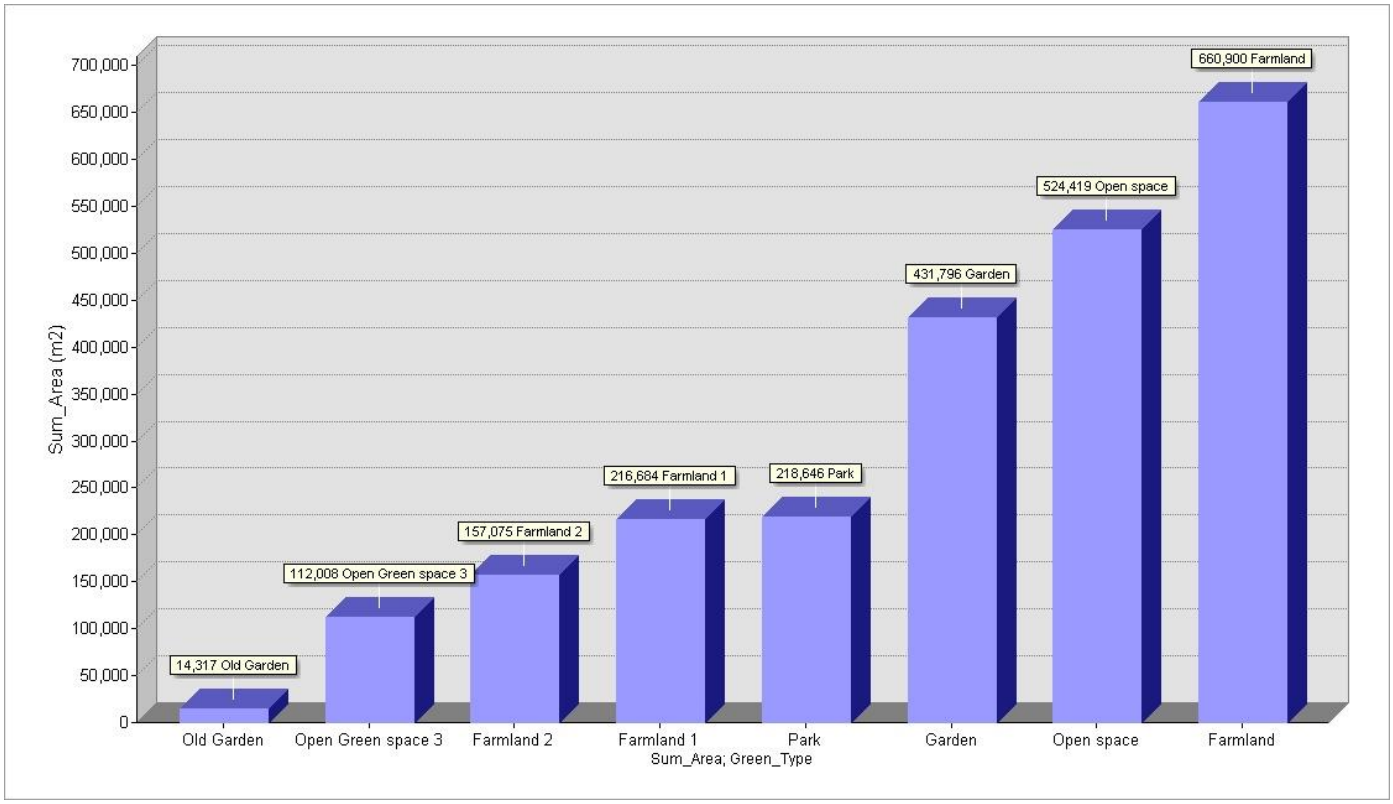
Source: The author using the data from Saravand Consulting Company

Figure 7.8: The contradictions between the research green lands categories and the suggested zones of the Detailed plan in region 18



Source: The author using the data from Aban Consulting Company

Figure 7.9: The amount of the research green lands categories which can be destroyed by the suggested zones of the Detailed plan in region 18



Source: The author using the data from Bafte-e-Shahr Consulting Company

By implementing the Region 18 Detailed plan 203 urban parcels of farmland (defined by the Detailed plan itself) out of 500 will go under non-preservation zones. This amounts to 1,163,234 m^2 of the total 8,143,867 m^2 farmlands of this region. These are the parcels which have been labeled farmland in the current land use map of the Detailed plan. The same procedure for the gardens is as follows: 4 urban parcels out of 35 gardens will be destroyed which comes to 40,714 m^2 of the total 361,560 m^2 garden parcels. This surface area of the destroyed gardens is almost 10% of the destroyed garden category of this research. Since the categorization of the farmlands is different in this research from the Detailed plan, the comparison between these two will not be rational. Moreover, farmlands change is faster than gardens and the data of the farmlands in the Detailed plan are relatively old for this change speed. Thus, many parcels which have been distinguished as farmlands in the Detailed plan are either constructed or turned into fallow lands in the aerial photos used in this study.

All in all, according to the new green categories of this research, the minimum total surface area of the trees/green surface which will be destroyed by implementing the Detailed plans comprise 32% of the total green area of the three selected regions for this study (Table7.1). This amount is so sizable that it cannot be neglected; therefore, setting policies against this process is on the top of the list of the priorities of this chapter.

Table 7.1: The amount and the percentage of the research green lands categories which can be destroyed by the suggested zones of the Detailed plans in the case study regions

Region	Area (m^2)	Total green categories of the research (m^2)	Area of destroyed green lands as percentage of total green categories
Region 1	5,410,931	12,895,110	41%
Region 2	3,549,191	11,677,732	30%
Region 18	2,335,845	10,723,028	21%
Total	11,295,967	35,295,870	32%

Source: The author

These calculations try to show that the destruction of green lands happens two times by the unsuitable urban planning system in Tehran. First, when the garden is being defined and many green landcovers are not categorized as gardens and second when the new zoning maps ignore their own status quo study. The parcels which have been labeled as garden in the current land use maps have mostly been covered by the non preservation zones. This highlights the fact that new regulations should be implemented into the urban plans, otherwise the city may lose up to 32% of its green surface by the legal plans.

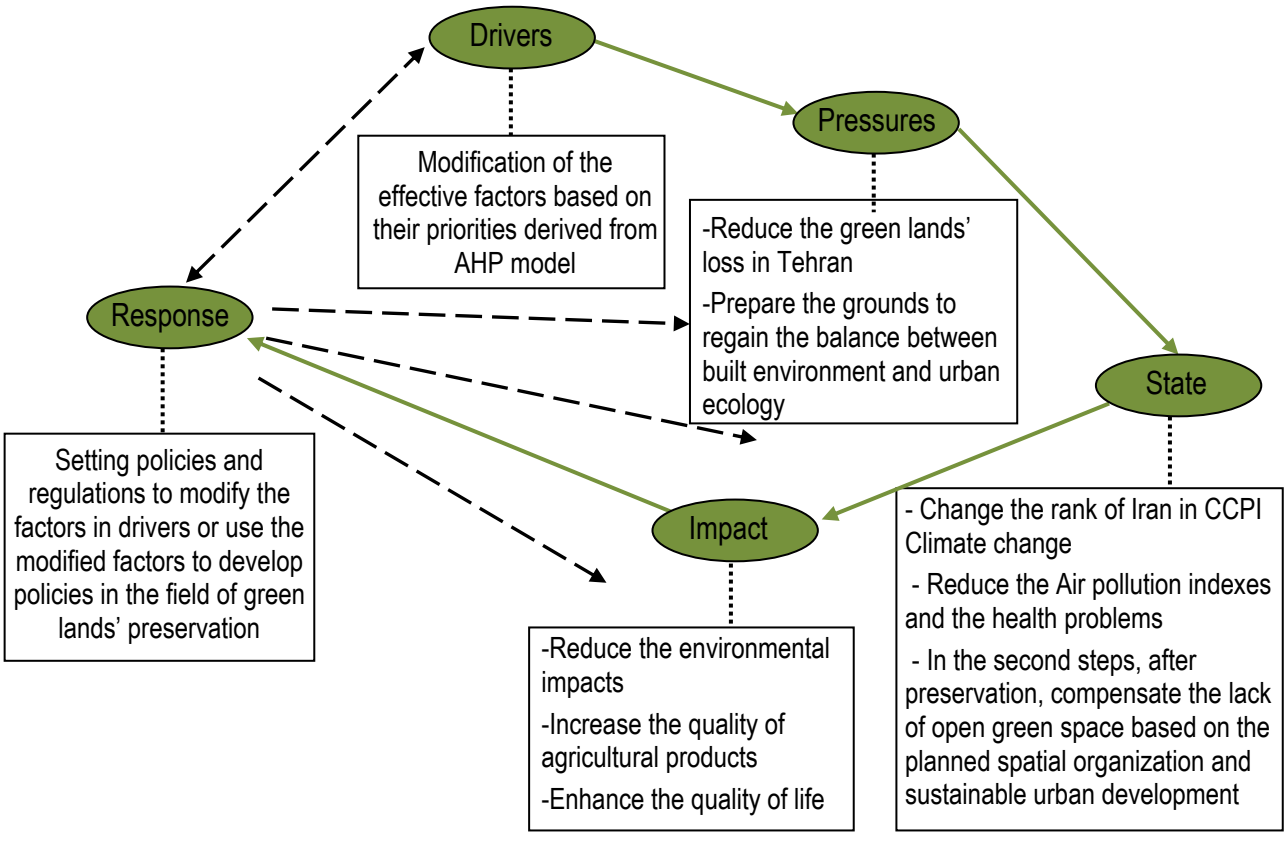
7.2 Aims (Macro-scale)

In this part the general aims without taking into consideration the regions' characteristics will be presented; thereafter, the proposals will be developed for each region and each green category created in chapter 5. The aims are based on the summaries of the chapters 2 to 6, whereas the proposals focus more on the local qualifications of the place, time and texture of the green lands which have been processed in chapter 5 and 6.

The general idea behind the development of aims is to solve the preservation problem in Tehran by a multidimensional approach and by combining the results of the various studies with the different priorities extracted from the methodology section.

Referring to analytical model in the form of DPSIR (Chapter 6), the current "state" in Tehran which is the result of the "pressures" on the land is not acceptable for any resident or planner; therefore, to reduce the "impacts" it has on environment and people's lives the mission of the planner is to modify the "drivers". This can be accomplished by setting the policies as a "response" to change the severity of the "pressures" on the land and urban ecology. The reduction in the harshness of "pressures" will ease the burden on the present "state" of all city aspects. Since the change in state has influences on the "impacts", this cycle will automatically go forward. As shown in figure 7.10 different elements of the model have interrelationships with each other and affect each other's functions.

Figure 7.10: Modification of the DPSIR analytical model according to the aims



Source: The author

Thus, any policy making has to be prepared by the modified factors in the driver section of the model. Since the modified dimensions of sustainable development (Socio-cultural, economic-financial, institutional-juristical and eco-urban) have been the main theoretical framework of the thesis and the effective factors in destruction of the green lands, in this part for each dimension (set of factors in drivers) the general aims will be presented as figure 7.11. It should be noted that the sub-criteria of the factors in the figure have been arranged according to the priority results of the AHP model in the Expert Choice software (End of chapter 6). Figure 7.11 has identified the objectives to reach the main aim in each set of factors and in DPSIR model of figure 7.10. Consequently, this procedure is more practical and has been used as a tool to reach the goal. The factors written in red are the ones which cannot be easily modified by this study. They are mostly on the national scale or depend on the affects of the international policies on Iran. Some others have their origins in the cultural characteristics of the society and can be influenced by the socio-cultural programs/workshops but cannot entirely be changed, at least not in a short time. The green parts like the red ones show that the situation cannot be changed by this research but, in contrast to them, these procedures can be stopped by setting the right regulations. The consequences of the previous actions still remain but the whole process can be ceased.

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities in AHP model to achieve the aims in DPSIR

Priority from AHP model	1 Economic-financial (0.510)[1]	2 Institutional-juristical (0.298)	3 Socio-cultural (0.116)	4 Eco-Urban (0.77)
1 (first priority in the group)	(0.269) *Density sale*: Selling density in the green parcels has to be substituted by other sustainable revenues.	(0.179) *Presence of municipality in Commission Code 5:* The municipality has to be excluded from Commission Code 5 or its power has to be reduced. Since it financially benefits from the decisions in this commission, he can be a member for technical terms and cooperation/consultation but without the voting right.	(0.278) *Request for living space:* The request for living and activity space which has been the consequence of the population growth in Tehran is not a criterion that can be altered in this study.	(0.169) *Permission for high-rise:* Implementing the Comprehensive plan that has forbidden any high-rise construction in Tehran. Changing the meaning of high-rise from 12 to 6 floors.
2	(0.139) *The considerable difference between land price and apartments*: The gap between land and apartment price has to be closed. When the garden receives added value, this gap will automatically be decreasing.	(0.133) *Malfunctions of article 14 of Urban Land Code:* This article has mal-functions which need amendments and transparency in the different aspects. It should either be modified or re-written with a completely new approach but by considering the same base.	(0.163) *Undeveloped centers:* The underdeveloped spatial organization, business and activity centers cannot have a big change by conducting this research.	(0.148) *Educational gardens:* Setting the new regulations for the educational-garden parcels.

[1] The priority in each category according to AHP model using the Expert Choice software.

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities (Continued)

Priority	Economic-financial (0.510)	Institutional-juristical (0.298)	Socio-cultural (0.116)	Eco-Urban (0.77)
3	(0.135) *Separate specific budget for the municipality:* There has to be specific financial resource for the city services. Without that the city has to use selling density or change the garden land use to cover its expenditures. This budget can be generated by using the gardens as a potential for defining new urban activities.	(0.110) *Lack of surveillance on the commission:* The decisions in Commission Code 5 have to be patrolled by an appropriate body to investigate the potential contradictions with the approved laws and preventing the green loss. People representatives have to reflect their ideas in the decisions as well. This brings an automatic surveillance of the residents on the urban planning.	(0.163) *Population growth*: Population growth has to be planned and organized by the higher authorities.	(0.116) *West-East tunnels:* The construction of the tunnels which has destroyed the Qanats cannot be changed by this research but any new urban project has to have anecological assessment before implementation. Qanats have to be considered as one of the most important elements to be preserved.
4	(0.099) *Organized tax system:* The most successful examples in the world have used a creative tax system to generate the financial resources for preservation. If social justice is considered as one of the aspects in sustainable development, the tax system in Iran has to be modified. Since it is a capitalist society, the share of tax in people's lives cannot be as strong as the European socialist-democratic countries but residents who use the benefits of gardens or who earn an enormous amount of money in the building industry have to be taxed with a fair portion.	(0.107) *Commission Code 100:* The initial reason for establishing Commission Code 100 has to be re-announced and clarified both for the residents and the urban authorities. Preventing the fractions is different from paying penalties for the fractions. In the first phase, the function of this commission for the green lands has to be repealed.	(0.094) *The owner's generation changes:* The generation change made an enormous change in people's life style after the revolution. The new life style is trying to adjust to the new values, spaces and possibilities in the society but there can be cultural programs for children and adults to recall the value of the nature and the natural environment in the human life.	(0.093*) Cultural-gardens:* Setting new regulations for the cultural-garden parcels.

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities (Continued)

Priority	Economic-financial (0.510)	Institutional-juristical (0.298)	Socio-cultural (0.116)	Eco-Urban (0.77)
5	(0.090) *Land use conversion:* The green to non-green land use conversions have to be excluded from the municipality revenues.	(0.106) *Commission Code 7:* The existence of Commission Code 7 as a specific commission for the gardens is in general a good idea which has to be followed in the regulations as well. However, the legal terms and criteria to distinguish gardens have to be updated according to the new scientific methods such as aerial photos analysis. More details of each parcel and the quality of its green land have to be taken into consideration. The decisions have to be taken based on the real data which is more than just the parcel land use in urban plans or the official deed. In addition, the activities of this commission and the results of its studies have to be clear to everyone. Moreover, the management structure has to be altered as well.	(0.076) *Tradesmen*: The wealthy owners including tradesmen cannot be excluded from the land market but the market circumstances can be harder to discourage partly developers-speculators' activities.	(0.076) *"Garden" land use in the plans:* Producing the ecological network map in the Tehran Preservation Institute[1] which contains a specific layer for the gardens and the agricultural lands categorized based on their qualities. This layer has to be considered above all the urban plans as the preservation parcels.
6	(0.069) *Added Value for green parcels:* In developed countries like Germany the value of the land which can be developed is more than gardens as well; therefore, the balance between the green and built environment is an aim which is being followed. Either giving extra rights to the gardens which have monetary value (like	(0.068) *Unlimited power:* When any element gets an extensive power in an urban system, the whole balance will be hard to be kept. The power of Commission Code 5 has to be shared into different organizations/ characters and this is related to the first and the third criteria. In other words, by excluding the municipality from the Commission and by increasing the control on	(0.048) *Introduction of suburban gardens into the city*: Due to the fast population growth in Tehran, the suburban gardens and farmlands have been incorporated into the city boundaries and this is not a criterion which	

[1] Explained in further parts

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities (Continued)

Priority	Economic-financial (0.510)	Institutional-juristical (0.298)	Socio-cultural (0.116)	Eco-Urban (0.77)
	the commercial land uses) or a green-balance system is required. The last option is a tax system for the residents using the financial advantages of the gardens.	its decisions, its power will unquestionably be reduced.	can be influenced by this research.	(0.062) *Private ownership:* Categorizing the regulations based on the ownership. Private ownership has to more strictly be regulated.
7	(0.067) *Financial guidelines of the municipality:* Municipality has to enter a part of its properties or reserve lands for the urban services into the garden system as a compensation for the preserved gardens.	(0.058) *A comprehensive definition for "garden":* A new definition of garden has to be developed which comprises all the details on the land cover of the parcel and the quality of its green texture. The green parcel has to be separated from its urban land use which will be called "ancillary use" in the forthcoming regulations. Any urban land use can be a garden and the gardens are not categorized in the same group. They need to be part of an ecological plan.	(0.041) *People's surveillance on the organizations:* People's participation has partly been realized by their surveillance on the urban organizations. It has to be written in the new regulations that anyone in the city has the right to obtain sufficient information about how the city sections fulfill their tasks.	(0.054) *Barracks-gardens:* Setting regulations for barracks to be a part of ecological network and under preservation.
8	(0.060) *Financial issues of the owner:* The gardeners/farmers need enough support in the form of subsidies or tax reductions to keep their green parcels; therefore, in the regulations the formation of the tax system will be strongly considered.	(0.044) *Weak function of the Ministry of Environment:* The management structure of Commission Code 5 has to be altered in a way that the Ministry of Environment gets more power and influence on the decisions.	(0.034) *New rich:* This group's values or their children's values should be influenced by socio-cultural programs during the time.	(0.044) *Road network:* The road network which has been constructed according to the Master plan and destroyed the water resources cannot be changed. However, any further west-east road construction has to consider the Qanats currents.
9	(0.040) *Construction as the main national industry:* It is not realistic to expect a doctoral research to change the main industry of a country.	(0.038) *Paragraphs 269 and 329:* These two paragraphs officially have to be annulled. The existence of different laws, codes and rules parallel with the new amendments	(0.025) *Wealthy buyers:* The approach to the wealthy buyers/developers is the same as the fifth criterion.	(0.040) *Fragmented gardens:* Setting regulations to give priority to fragmented gardens and make connectivity between them.

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities (Continued)

Priority	Economic-financial (0.510)	Institutional-juristical (0.298)	Socio-cultural (0.116)	Eco-Urban (0.77)
	Thus, this factor cannot be directly influenced by a single research study. In addition, this problem stems from the whole political situation of Iran in the world. However, it can be claimed that it will be tried to highlight other beneficial activities in the urban system by highlighting the status of ecology and nature.	make the legal situation of the preservation complicated. Thus, any new law can only be successful if it gains the whole legislative-executive power.		
10	(0.032) *Closed system for gardens:* The money earned from any activity or service concerning the green lands has to be invested in their preservation. This requires a closed financial system for the gardens which does not intend to cover other expenses through the green lands. This is in conjunction with the third criterion and excluding the gardens from the municipality revenue. Only such a system can be successful in implementing TDR (Transfer Development Rights).	(0.030) *Separating gardens affairs:* The garden affairs have to be categorized according to their types and are allocated to separate the sections cooperating with each other. The financial terms, legal status, implementation circumstances and the surveillance have to be separated from each other. However, this does not prevent any cooperation or collaboration in the whole system.	(0.025) *Wealthy owners*: There is a possibility to influence the owners who are not super rich by subsides, incentive programs, Green Right and a new tax system which will be implemented in ecological-financial factors.	(0.035) *Health gardens:* Setting new regulations for the gardens with health land use.
11		(0.028) *Land use conversions from green to non-green:* Any conversion of this type has to be prohibited in Commission code 5. It should be noted that the term “garden” and “green parcels” are substituted by the 10-green-categories.	(0.023) *Cost-benefit analysis on the urban projects:* The grounds for the people’s participation have to be prepared by letting them share	(0.033) The *Weak position of gardens in the Master plan:* Entering the layer of garden and farmland from the suggested ecological network map into the Master plan.

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities (Continued)

Priority	Economic-financial (0.510)	Institutional-juristical (0.298)	Socio-cultural (0.116)	Eco-Urban (0.77)
			their ideas through cost-benefit analysis for each new urban project.	
12		(0.024) *Weak function of the city council:* One of the main tasks of the city council is to survey the municipality activities but this task has to be fulfilled more seriously. For this intention, the city council needs to regain more power in the urban planning system. The other alternative is to identify a new structure for this mission.	(0.009) *Upper-middle class:* Upper middle class and their emotional relationship to the region have to be used in the direction of workshops and cultural programs. It is the most effective social class in the preservation activities.	(0.025) *Flexibility in the Detailed plans:* Limit the detailed plans flexibility to fewer land uses and choosing green land uses have to be accompanied by the incentive programs.
13		(0.019) *Unclear function of Commission Code 5*: The function and approvals of Commission Code 5 have to be made clearer to the public and urban planners. The limits of its power have to be determined.	(0.009) *NGOs:* Green NGOs have to be formed in Tehran with a defined goal of preservation by the support of international foundations.	(0.025) *Deep cellars:* The parking lots and cellars of the new high-rises have to limited to the certain heights and consider the location of Qanats.
14		(0.019) *Ersatzflächenpool:* The feasibility of the new methods of preservation used in the developed countries have to be examined in Iran. Ersatzflächenpool or keeping the balance between green and built environment is one of these suggested programs.	(0.008) *Non-native residents:* The approach towards non-native residents is the same as the fifth criterion.	(0.019) *Unclear Urban ecologic data:* A complete archive of green parcels with their qualities and characteristics has to be developed in the TPI as a data base for the gardens.
15		(0.014) *An independent organization for gardens*: There is a missing organization related to gardens affairs in the urban management	(0.004) *Immigrants*: The approach towards immigrants is the same as the fifth criterion.	(0.015*) Public ownership:* The ownership has to be taken into consideration in the regulations. Public ownership is

Figure 7.11: Different objectives in each set of factors and sub-criteria based on the priorities (Continued)

Priority	Economic-financial (0.510)	Institutional-juristical (0.298)	Socio-cultural (0.116)	Eco-Urban (0.77)
		structure. As a result, different responsibilities have been separated in different organizations at different levels. Anything concerning the green lands has to be accumulated in one unique institute with different sections specialized in various tasks such as finance, management or legislation.		less threatened than private ones. However, land uses such as school and hospital have to be excluded from this category.
16		(0.011) *Incentive/deprived regulations:* The regulation approach has to be altered. The preventive regulations have to be substituted by the incentive ones.		(0.015) *Hierarchical preservation plans*: Preservation plans have to be prepared according to different urban scales and based on the garden data bank in the TPI.
17		(0.007) *"High Council of Surveillance on Tehran Expansion" is dissolved*: A similar organization which is effective in controlling the city expansions has to be re-established.		(0.012) *The parcels with no land use:* These parcels have been given land uses in the new plans and cannot be changed in this study.
18		(0.004) "*Master and Detailed plans Production Organization" is dissolved:* This organization with high technical potentials which controlled the general function of the municipality in details and worked as an consultant for it have to be re-established.		(0.010) *Low-quality agricultural products:* The agricultural products which have been ruined by air pollution and have influenced the economic situation of the owners cannot be changed.
19				(0.008) *Connected gardens:* These gardens have to be preserved as a zone.

Source: The author

According to the figure above the main aims in each set of factors by taking into consideration the priorities will be as follows:

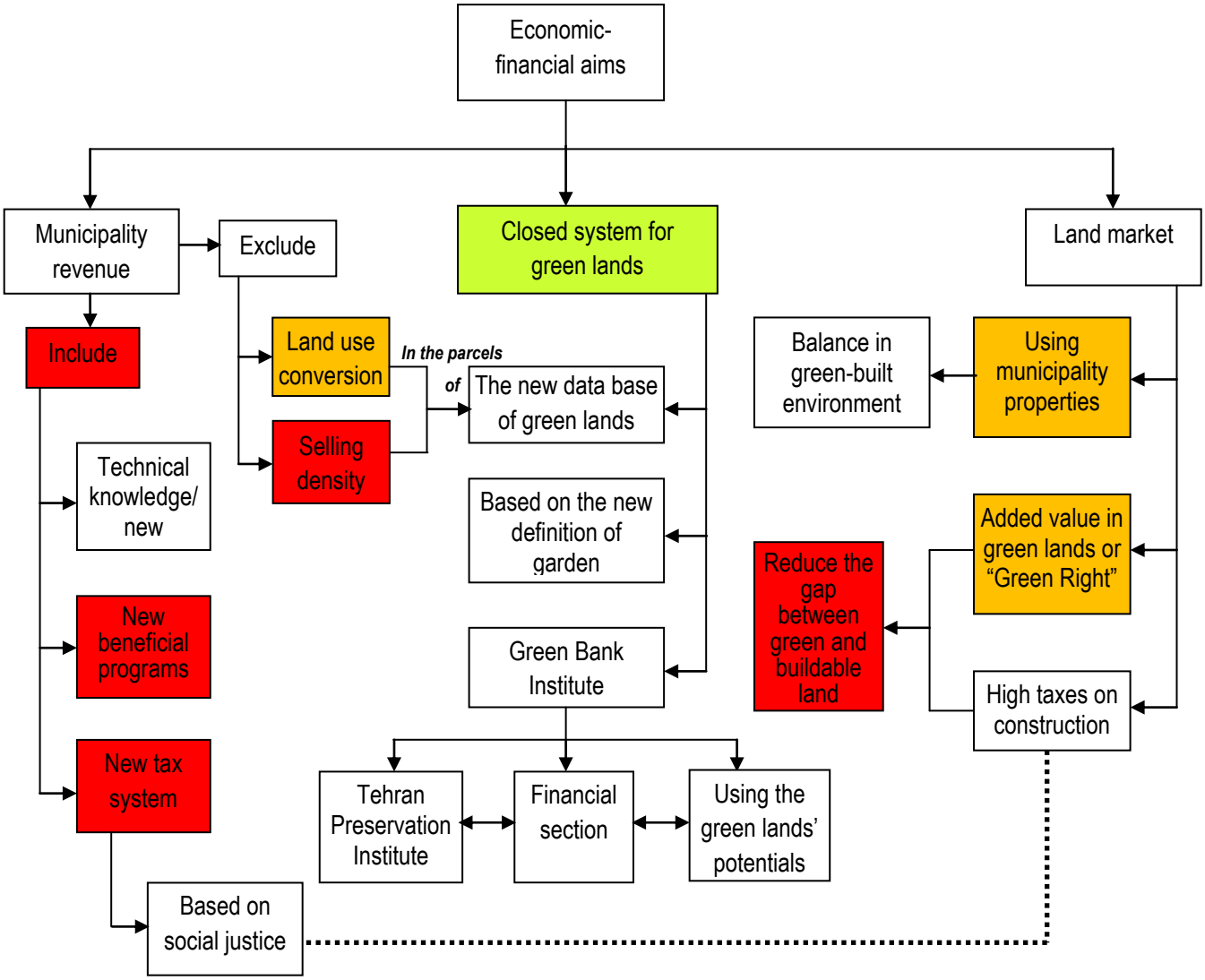
Economic-financial aims: The municipality revenue system needs a complete revision. The Green land use conversion and selling density in the green lands have to be excluded from this system. Instead of the two deleted financial resources of the municipality a new tax system has to be developed based on the reality of the income data (to the extent it is available) to implement social justice. The other substitute financial resource can be derived from the technical and the scientific data municipality owns. With this potential it can enter more urban projects and collaborate with the big companies by selling new technologies to them. More alternatives will be discussed in the next sections. In addition, municipality has to use its properties as compensations to help the city take back its built-green balance by different creative programs such as Ersatzflächenpool explained in the next group of factors. A closed system just allocated to green lands' financial affairs which uses the revenues to cover the preservation costs has to be defined. The green lands have recreational, leisure and food production potentials which can be used to generate a certain financial support in this close system. This system which is called "Green Bank" and is the initial core of the "Financial section"[1] in the "Tehran Preservation Institute" or TPI which will be explained in the next factors. It can be stated that with enhancing the garden status in the urban ecology, more money will be invested in preservation and covering many expenses will be easier. The added value to the gardens or allocating the new rights to them can be a solution to reduce the gap between a garden parcel and a buildable land. This can function like the commercial lands that have additional value compared to the adjacent residential land. The higher the value of this right, the higher the status of the gardens on the market and the less the profit gained by garden destruction. Figure 7.12 shows the main aims of the economic-financial dimensions which are the results of the objectives in figure 7.11 and are categorized according to their priorities in the AHP model. It has to be highlighted that some of the sub-criteria have been used within the aims or some of the aims have been developed by the combination of the couple of sub-criteria; therefore, the priority could not be allocated to these sub-criteria in this model.

Institutional-juristical aims: There have to be certain modifications in both the institutional and the juristic structure. In order to have a firm and unchangeable new management structure, the preservation and its related system have to be officially written and supported by a new act. According to the universal successful examples, any preservation management body has to be supported and established by a powerful approved act[2]. In the next part it will be tried to develop such regulations in Tehran. According to the priorities in the AHP model the first modification has to be made in Commission Code 5. The power of this commission in the system has to be reduced by the following actions: Municipality as a member who cover a part of the city expenditures by land use conversion approvals has to be excluded from the commission. The better alternative can be to have it as a technical and professional member, but without the right to vote. This increases its engagement and collaboration without the financial interest concerning the commission decisions. As the most crucial land use conversions are the ones related to the urban ecology, more power has to be given to the Ministry of Environment in the commission. This ministry has to have two rights to increase its power. It has to use his professional point of view to prevent any green land destruction in Tehran. The old methods of decision-making only based on the urban plans have to be improved by using the knowledge of this ministry. The TPI has to be present in the commission as well. It has to check the consistency of the decisions with the Green Archive and help the commission make their decisions based on the new aerial photos. Moreover, the function of this commission has to be limited to the non-green parcels in Tehran. Green to non-green land conversions ought not to be discussed in the meetings. To implement this later, the new definition of garden has to be used. The third modification in the management structure of the commission is to have both official and people surveillance on the commission meetings/decisions. This control has to be defined for all the executive elements of the urban system such as the municipality itself. Currently, the city council is responsible for surveying the activities of the municipality. Either this power has to be increased or a new institute has to be established in the form of the mentioned management act to fulfill this surveillance of the municipality and all the commissions.

[1] Called the "Department of Green Finance"

[2] As an example ALC in Canada has been the result of implementing the Land Commission Act of 1973.

Figure 7.12: Economic-financial aims and their priorities in the AHP model



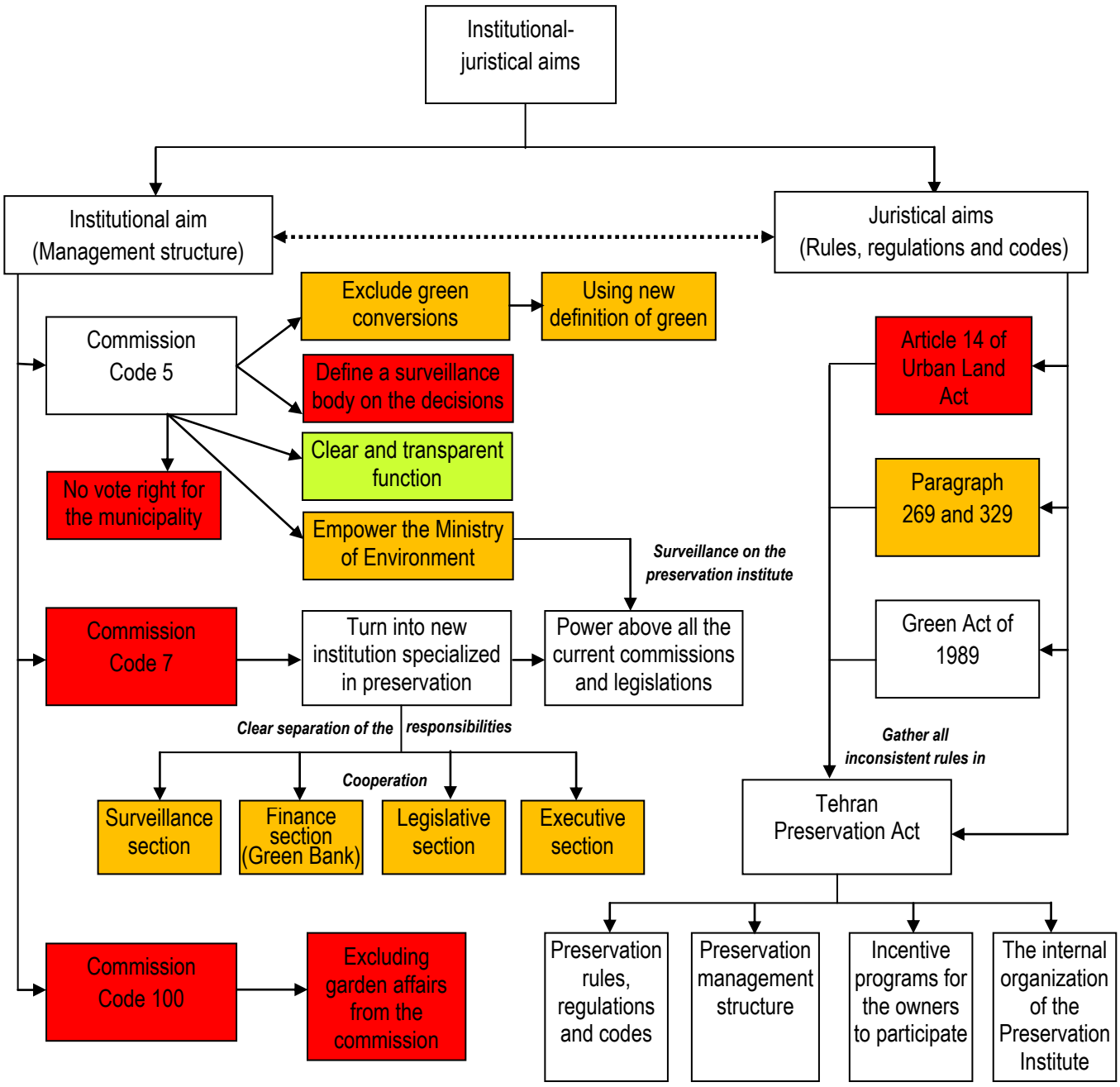
The priority according to AHP results in the Institutional-juristical category with respect to green lands' preservation

Low (0.060-0.032) | Medium (0.090-0.067) | Very high (0.269-0.099)

Source: The author

The second part of the aims in the institutional-juristical aims is to modify/re-produce the regulations/rules/laws/acts concerning the green lands preservation and their institutional structure in Tehran. These acts have to present solutions and proposals for the following fields: the exact rules and regulations concerning preservation based on the new science and international experiences; the incentive programs for the residents to keep and support the gardens and agricultural lands; the exact structure of the preservation institutions, their staff and functions; the formation of a commission or institute specialized in the preservation with different sections (finance, management, surveillance, law) with more power than all existing commissions (Commission Code 5, 7 and 100) and all the existing parallel rules (Green act, Article 14 of the Urban Land Code, Paragraph 269 and 329); accumulate all the current inconsistent rules relating green space, gardens and farmlands in one unique Code which improves the existing legal deficiencies and complications and is as transparent as possible; using the new technology such as the aerial photos in the decision-making procedure on green lands rather than old urban plans with insufficient data. Figure 7.13 shows the main aims explained above and the related modifications which are the results of the objectives in figure 7.11.

Figure 7.13: Institutional- juristical aims and their priorities in the AHP model



The priority according to AHP results in the Institutional-juristical category with respect to green lands' preservation

Low (0.019-0.004) | Medium (0.068-0.024) | Very high (0.179-0.106)

Source: The author

Socio-cultural aims: Most of the criteria in this group, especially the ones with the highest priorities cannot be influenced by this study and consequently no specific aim can be defined stemming from them. They are mostly national problems which should be avoided in Tehran urbanism in the future. However, these criteria have very low priority in the final evaluation of all criteria. The first three criteria which are interrelated to each other are too extensive to be influenced by this research on preservation. The population growth which increased the request for living space forced Tehran to have the built environment and the activity centers in a short unrealistic time and this led the city development to the unplanned spatial organization. The green lands have to be a part of the current city spatial organization, integrated in the plans and reconcilable. However, a group of aims can be

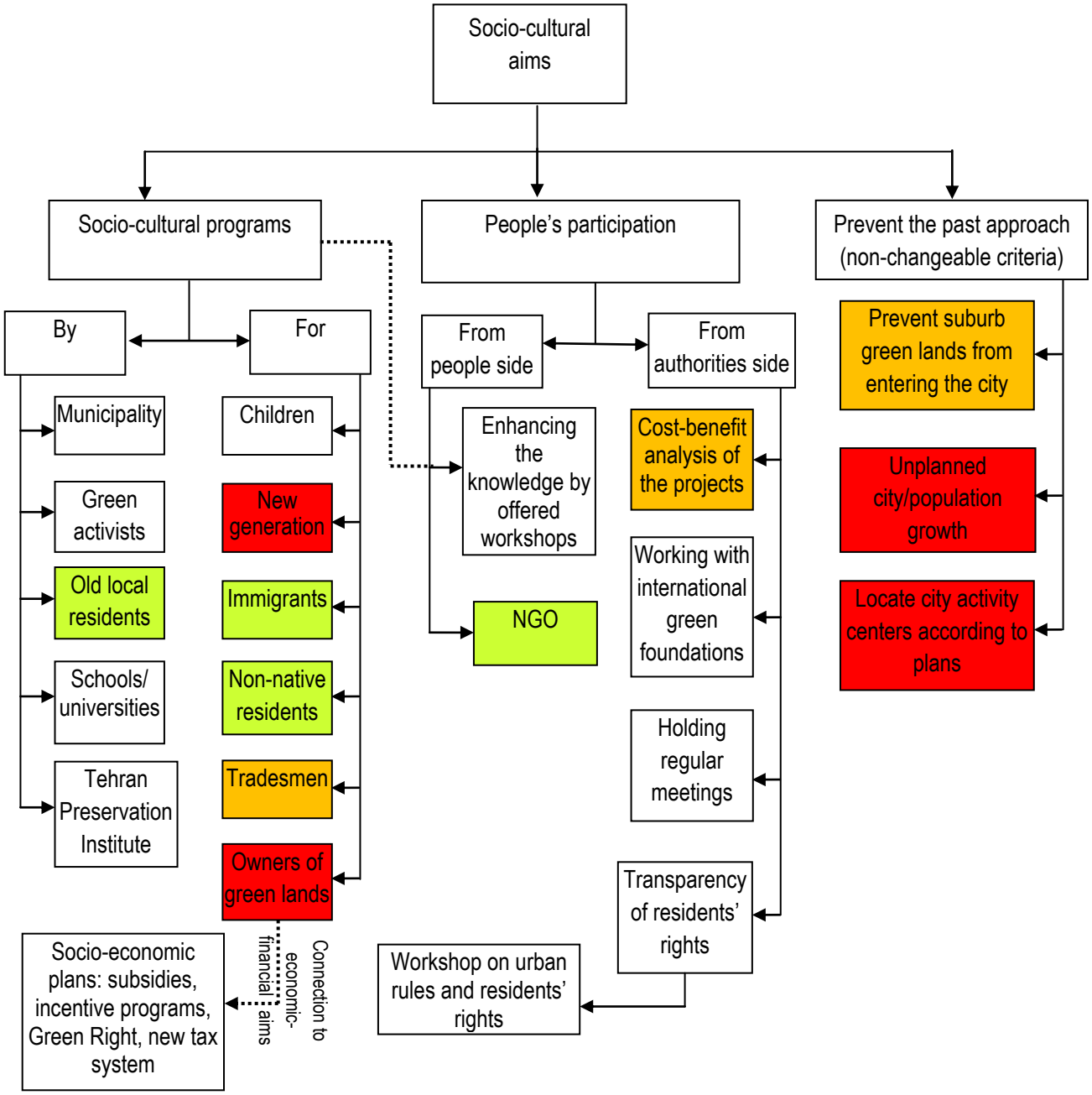
presented to prevent the separation of urban land uses and green lands in the future (Figure 7.14). The first consequence of this unplanned city planning was incorporation of the suburb green lands into the city which has to be prohibited in the future. When a green land becomes a part of the city, its preservation becomes harder due to the fast city developments. Another consequence was the creation of the activity centers inconsistent with the legal urban plans which have to be controlled in the future of the city. The formation of such centers in the north of Tehran ruined many green lands.

The second set of aims is to work on different social groups, their ideas, culture and values. This is relatively easier than the changes in the first group and they can be influenced by the creative new socio-cultural programs. The research concentrates on these programs on the Meso-scale guidelines in a legal framework and on the micro-scale proposals in the regions. People's life style changed due to the new economic and cultural circumstances but people's values still need time to change completely. Many of the people do not believe that the green natural environment has to be treated as it is being treated right now in Tehran and this shows that they can be still motivations for people's participation; therefore, this set of aims function very closely with the third one which comprises people's participation. However, the base of the aims is as follows: the programs will be offered by the cooperation of the municipality, TPI (the suggested organization for green lands' preservation in this thesis), green activists, schools and the upper-middle class or old native residents of each region.

The old native residents still stick to their old values and can be used as a nostalgic members of each region who defend the preservation due to their emotional relationships to the place. These are their history, youth, childhood and memories for them. On the other side, the programs will be offered to green lands' owners, to the new generation, children, immigrants, tradesmen and non-native residents. There will be special socio-economic plans for the owners of the gardens and the farmlands which focus on enhancing their quality of life, solve their economic problems and increase their believes in keeping the gardens. This part will be mainly explained in incentive economic programs.

The last category of aims which has to be followed in the socio-cultural factors comprises the people's participation in the preservation. It includes two sides which are complementary to each other: the people's side and the authoritative side. There has to be a possibility offered by the authorities to people to give their ideas about the urban projects and if they agree to invest the city budget on the big projects. Thus, a cost-benefit analysis before each city project more than a certain amount of budget has to be obliged. The possibility of working with international NGOs, charities and green organizations has to be supported by the government. This connection can be implemented by the TPI. Moreover, the regular meetings between this institute and each region's residents on the preservation plans' progress are necessary. Last but not least urban authorities have to present the workshops on people's rights which try to make the residents' rights clear and transparent to them. They need to know the city rules and the rights they have relating to them. These workshops can be combined with socio-cultural ones which have been explained before. From people's side more NGOs have to be established and work actively with other social elements of this model (Figure 7.14). When the city residents see themselves as a part of the city decision-making procedure and as members who will be asked about their ideas on the projects, they feel more responsible, attend the local workshops more actively and enhance their knowledge about the city problems and the eventual solutions.

Figure 7.14: Socio-cultural aims and their priorities in the AHP model



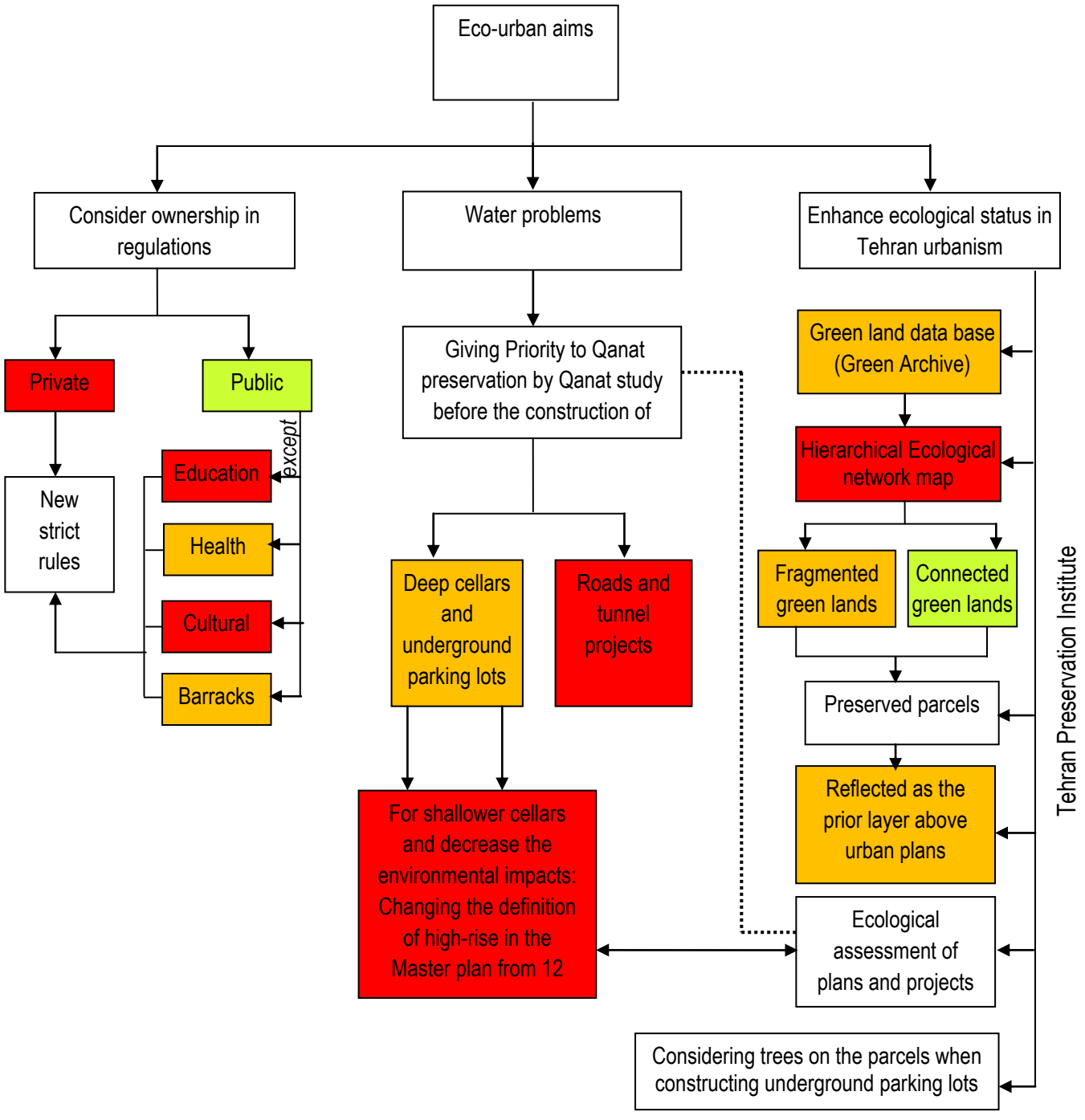
The priority according to AHP results in the Institutional-juristical category with respect to green lands' preservation

Low (0.009-0.004) | Medium (0.076-0.023) | Very high (0.278-0.094)

Source: The author

Eco-Urban aims: The aims in this group have been categorized in three main ones. The criteria which cannot be changed in this research have not been presented in figure 7.15 but have been explained in figure 7.11. Before the recent Detailed plans there were some parcels in the urban maps marked as "no land use" in the legend. These parcels have mostly been turned into built-up ones and this procedure ruined the suitable potential they had in creating the new green spaces inside Tehran. Some of them were also green in land cover but not registered as garden or green space in the official plans. This process cannot be changed or ceased; currently, all those parcels have urban land uses.

Figure 7.15: Eco-urban aims and their priorities in the AHP model



The priority according to AHP results in the Institutional-juristical category with respect to green lands' preservation

Low (0.015-0.008) | Medium (0.54-0.019) | Very high (0.169-0.062)

Source: The author

The lack of a complete data base is one of the biggest problems of preservation and has to be solved by the suggested Tehran Preservation Institute. Tehran has to enhance its ecological plan for each urban scale. All the green parcels have to be categorized in the similar way it has been conducted in chapter 5 of this study. The qualifications of the green textures and their priorities in preservation have to be ordered. This archive prepares the grounds for the ecological network plan of Tehran which has to be reflected in both the Comprehensive and the Detailed plan. Similar to Germany the urban plans have to pass the "ecological assessment" before approval.

The contradictions between the proposed land uses and the ecological network plan have to be removed and the plan has to put as small pressure as possible on the natural resources of the city. The so called "preserved parcels"[1] have to be included in the urban plans and they ought to gain the highest priority to any proposed land use. When a parcel is in the preserved layer, no matter what its land use is, it has to follow the ecological regulations of the ecological network plan to keep its trees/green texture. It should be noted that the current method of the preserved zones in the Comprehensive plan and the flexibility in the Detailed plans (Chapter 5) cannot be successful and will automatically be deactivated with prioritizing the mentioned layer to all existing zones. However, the proposed zones of the existing plans can remain and the preserved parcels can be overlaid on them. Another point which has to be taken into consideration in prioritizing the parcels is their form, either connected or fragmented. The connected ones have to be preserved as a green zone whereas the separated fragmented ones have to have stricter rules

Water problems for irrigating the trees have mostly been caused by intentional human activities in Tehran which cannot be changed. However, the whole process can be ceased by setting new appropriate rules. Most of the wells and Qanats have been dried out or destroyed due to urban projects. Therefore, before any tunnel or road construction especially in west-east direction or developing the plan for the parking lots or cellars, an ecological assessment report has to be implied concerning the impact the project causes on the natural resources. Under the new rules destroying the trees due to the extensive underground parking lots is forbidden. This means that the tree map of the TPI has to be taken into consideration before any parking lot construction.

In order to impose less environmental impacts on the city, the following tasks have to be fulfilled: the definition of the high-rise in the Comprehensive plan has to be changed. Currently, 12 floors and more have been considered as a high-rise building whereas in many cities around the world 6 floors and sometimes less have been set as the limit of the high-rise. In the second place, the narrow organic road network of region 1 has to be taken into consideration. Constructing 12 floors along these roads has already led to many eco-urban problems such as using the maximum capacity of the ground, destroying the green parcels for the sake of high-rises as well as insufficient infrastructure; the third point to mention is that these buildings must have deep cellars and parking lots which destroy the Qanats currents in their location. Therefore, reducing the number of stories in the high-rise definition can be a part of the ecological plan and advantageous from different ecological aspects.

Last but not the least, there is the important debate of ownership on the list. Ownership is so important that it has to be considered separately as a criterion to divide the suggested regulations. Private ownerships have to have stricter acts. Since among the public ownership educational, health, barracks and cultural land use have been more threatened by the constructions in the recent years, they have to have separate rules. This means that in the annual TPI inspections or when it has to decide for a parcel, one of the factors which leads to the stricter rules is the private ownership or the mentioned public ones.

7.3 Four-step synthesize phases

In the previous section the general aims based on the research theoretical base (Sustainable development) have been explained and categorized according to their priorities and dimensions. This is a combination of the AHP model and the modified dimensions of the sustainable development to alter the elements in the DPSIR model and consequently change the "status" of Tehran.

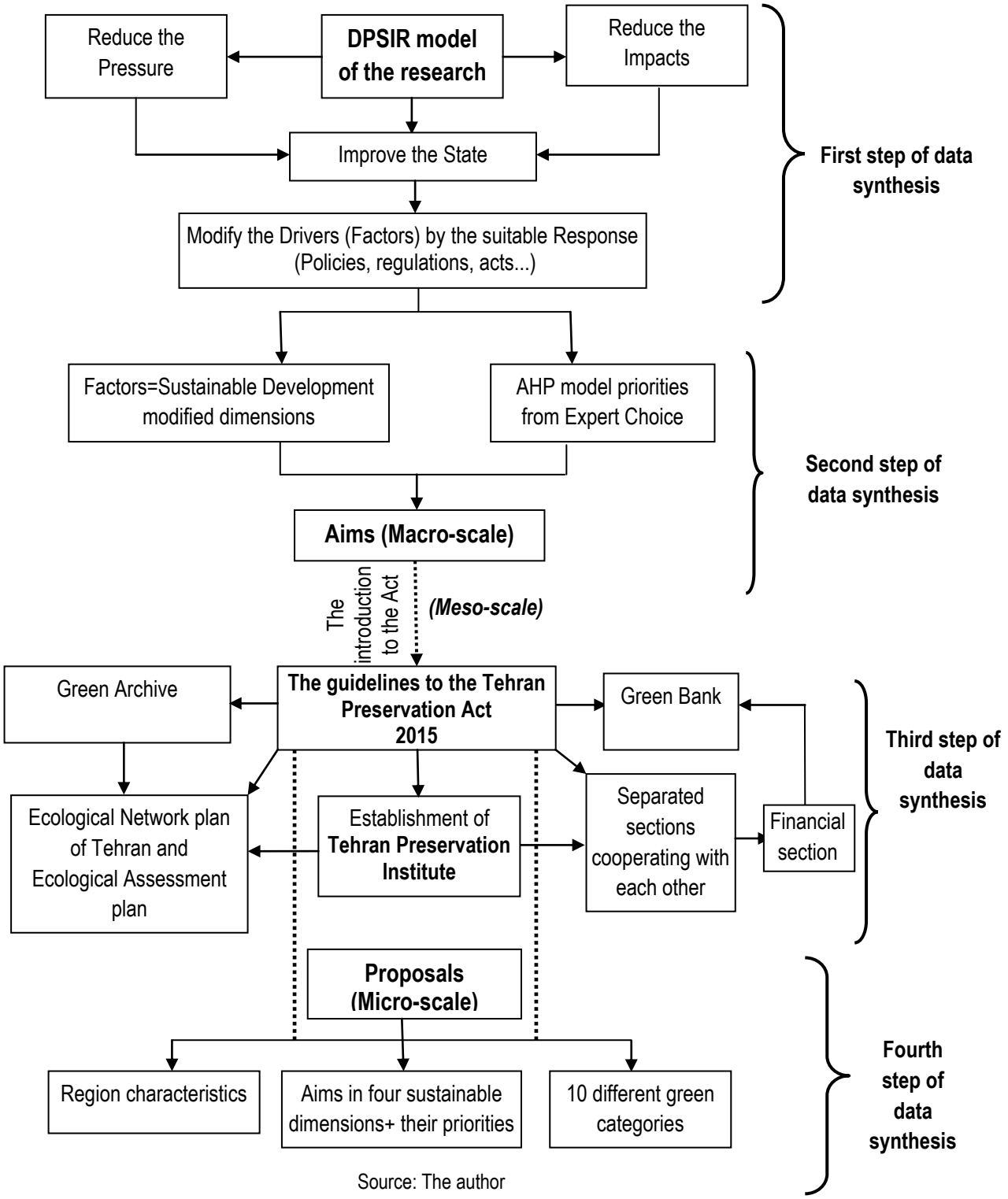
As shown in figure 7.16 the next step is to develop guidelines for the "Tehran Preservation Act" according to the explained aims. To have a better understanding of the detailed Meso-scale guidelines, an introduction has been prepared beforehand. Similar to the successful universal preservation plans, this act will be the base for establishing TPI. The duties, guidelines and policies of this organization will exactly be defined according to the outcomes of this research, aims and proposals, the improvement of the current unsuccessful laws and the result of the AHP model. The last phase is the micro-scale proposals. In this section the research will go one step forward and work on each selected region of the study with a closer zoom/scale. Here, the proposals which are

[1] The 10-green-categories which will be called Tehran Green Reserve (TGR).

based on the general aims of the last section will be presented in each region (Region 1, 2 and 18). This will automatically categorize the proposals into the four sustainable development dimensions and consider the importance weight of each criterion. Moreover, the green categories (Chapter 5) will be combined with the characteristics of each region (Chapters 3 and 5) to develop the proposals.

Since this study is multidimensional-interdisciplinary, synthesizing all the gathered analyzed data is one of the crucial phases of the research; by combining different factors in four steps the outcomes of each phase will have influence on the final acts. This way is easier, more organized and reliable and the analysis of the considerable amount of data in one step is not required.

Figure 7.16: How to develop the final policies and acts of the research



Source: The author

7.4 Introduction to the "Tehran Preservation Act"

Before developing the detailed guidelines to the "Tehran Preservation Act" an introduction has to be presented on the general framework and the concept of the act. The author is mainly inspired by the Canadian, American and German preservation regulations and tries to adjust them to the local circumstances and the characteristics of Tehran. Moreover, the current acts which have been explained in chapter 4 will be taken into consideration to improve the mentioned issues.

First of all it has to be highlighted that any classification system is useless and inadequate when it is used beyond the limited purposes for which it has been established. The classifications of green lands in this research is based on the theoretical framework and the approach followed in this thesis; therefore, the act which will be based upon this method of classification has to be followed with the maps, GIS data, tables and rules attached to it. Using a separate part will be misleading, incomplete and vain. This is a package, a system which has to be implemented by each of its elements. In addition, decision makers who lean on the presented data have to confront an integrated package and not the data which is useful for the planners to prepare this package.

The third point is that if the people's participation is intended, they have to be considered as a part of the plans preparation and therefore they need to understand the acts to interact with the planners, authorities and the local government. With the new technology and the enhancement of the general knowledge, people have become more aware of their rights and this interaction is easier than old times. It can be obviously predicted that the adoption of "Tehran Preservation Act" by the legislature of Iran will culminate concern, oppositions and complaints expressed by a variety of people and organizations. However, with a clear explanation on the consequences of the phenomenal rate at which we are losing our green lands and making the act transparent to everyone, the increment support will improve the act implementation. Since the planner has to be able to work his way through the politicians, his responsibilities becomes extremely significant here. It is his job to make the complicated technical acts palatable and credible enough for everyone whose job is to accept and approve it. Thus, in this act the base information will be described with these two points in mind and with considering the contentment of the both sides together with the improvement of the ecological status of the city.

To prevent the past failures in the preservation regulations and the problems the planners had to face and the implementation of contradictory parallel rules (explained in chapter 4), the importance of "Tehran Preservation Act" is so high that it takes precedence over all other legal provincial, local and national legislation, except G preservation zones of the Comprehensive plan. The G-zones have to be stabilized and if in any case they have not been included in the 10-green-categories of this research, the priority will be allocated to them. Only in this way the total preservation system can be able to change the situation. The previous acts are mainly based on the municipality, Commission Code 5 and codes which have been functioning relatively well more than 30 years ago. Moreover, the recent amendments have not altered the deficiencies which led to the green land loss in Tehran either. When a new management structure based on the new legislation is intended to be proposed, it cannot lean on the old acts. Thus, the new code will be formulated by taking into the consideration the positive aspects of the old ones and by trying to take distance from any procedure which ended up the preservation acts being the construction acts.

There are four main principles in the act: the "Green Archive", the establishment of the "Tehran Preservation Institute" and its management structure, details of preservation regulations and the complementary programs which comprise incentive and tax programs.

The "Green Archive" which can be the base for the ecological network plan of Tehran is the GIS maps which are geo-referenced and comprise the entire information about all 10-green-categories of this research (Chapter 5). Each piece of green land together with its texture quality, legal history, ownership, the priority, soil and ecological data has to be saved in this system's tables of content. The process is different from the existing Commission Code 7; currently, when the owner wants to build its property, he has to check with the Commission to ensure it is not a garden. If it is registered as a garden (in most cases means holding garden deed) and the owner claims that the parcels has no more the previous tree quality, he can appeal the land use change in Commission Code 5. In

this way, each case will be reviewed individually and one by one whenever there is an appeal application. In the new procedure of the institute there is a complete fixed, clear and unchangeable data base regarding all the green lands of the city and there is no dependency on the decisions of the different commissions or their points of view. It may need a first initial technical staff to prepare the maps and data but the complicated, time-consuming and controversial tasks concerning green lands will be excluded from the commissions and municipality structure. On one hand, the organizations can limit their responsibilities on the pure urban issues and therefore be more focused; on the other hand, a new management structure which is separated from the old system can be defined.

The second characteristic of the process is the technical base that would weather all storms, politically and otherwise, be as fair as possible to everyone and function as the base of the implementation of the social justice. For this matter, the land cover has substitute all former urban land use parcels and is chosen as the appropriate requirement in order to fairly and equitably apply green land classification. In the first step, similar to what has been accomplished in chapter 5 of the research, any kind of green surface on the aerial photos will be selected. In this phase there are blind eyes for ownership, the legal urban boundaries and socioeconomic issues of the land market. The mentioned debates will be used in the proposals and policies. This means that the legal urban parcel limits have to be converted to the natural green texture boundaries. The recognition of the parcels comprising the intersection of the green preservation category and urban land use will be discussed later.

The management structure of the TPI is based on the management studies in chapter 4. The very first task of this organization is to preserve the 10-green-categories which lead to preservation of any tree/green surface in Tehran. As explained in this chapter, different responsibilities relating to green lands have clearly to be defined and allocated to the certain management bodies. Fulfilling parallel tasks is to waste time and money and has caused many problems between the organizations. As the result, with the malfunction of the affairs concerning the green lands the green destruction has increased. Thus, the green land problems, plans, financial issues, revenues, acts, regulations and any decision made for them have to be concentrated in the TPI. The second point regarding the management structure is that the responsibilities must have clear limits and have to be separated from each other in the different sections of the institute. The sections are the departments of Green Finance, Green Planning, Green Implementation and Surveillance, Green Acts, Green Participation and Green Research. The section which organizes finance has to be apart from planning and decision making. This directs the guidelines and objectives of the institute towards a form of preservation with less economic intentions in the decision making. Moreover, preservation brings money to the institute not destruction. The base of working in the different sections is cooperation. This cooperation is internal and external and has to be the strongest focal point of all the institute activities because it has fiscal as well as nonfinancial outcomes for the whole system of preservation. With an effective cooperation the institute can maintain a policy of keeping its staff to a small, close-knit working group, thus avoiding the pitfalls or burgeoning bureaucracy. In ALR in BC of Canada (Chapter 4), for 4.7 million hectares of land only 25 members are working. The Green belt Foundation of Ontario which preserves more than 1.8 million acres of protected forest, farmlands, and wetlands have 24 members. SADC in Frelinghuysen of USA which administers grants to landowners in the Farmland Preservation Program to fund up to 50 % of soil and water conservation projects comprises 11 members. The Parks and Green Spaces Organization in Ghom, Iran which covers 14,500,000 m^2 green spaces has 25 members for the first 10 years since its foundation. However, due to the multidimensional problems, land speculation, socioeconomic issues and the cooperation complications in Tehran, a minimum of 20 members seems realistic. A proximate size of the staff according to the universal experiences for the three selected regions with around 35 million square meters of green lands (Figure 7.15) can be between 20-30 members. This number includes parks which will remain mainly with the Parks and Green Space Organization. The main effort will be invested in using expertise and assistance of other agencies of government and municipalities. This becomes more significant when it comes to data; different organizations, institutes, agencies and universities have already the main part of the necessary data that the preservation institute has to start gathering, analyzing and synthesizing. Some of these organizations are as follows: Ministry of Roads and Urban Development, The Information Organization of Tehran Municipality, Tehran Parks and Green Space Organization, Ministry of Agriculture, National Cartographic Center, Forest, Range and Watershed Organization and the Department of Environment. The cooperation will be beneficial for both sides;

TPI gathers the pure and raw data from these organizations and synthesize them with the data its staff has been working on. The result of the analysis will be maps, plans and ecological acts which will be sent back to each organization that has collaborated.

The cooperation starts from the first and the main tasks of the institute which is to complete its green database or the Green Archive. The staff has to use the latest aerial photos with the high resolution to classify the different green lands according to what is described in chapter 5 of this research. This step can be refined through fieldwork. In the second step, they have to send the maps to Forest, Range and Watershed Organization, the Ministry of Agriculture and National Cartographic Center and the Water and Soil Research Institute to overlay the soil quality and climate combination maps on the prepared maps. Parallel to this, the maps have to be presented to the Parks and Green Space Organization to correct, complete and stabilize the location and information on the parks. It should be noted that the responsibility of Parks will remain by the mentioned organization. TPI staff gathers the complete maps and sends the finalize version to each municipality in 22 regions of Tehran. Each of the 22 regional levels of the municipality is required to give their ideas on the green categories, their characteristics and boundaries according to their data and approaches. Afterwards, the completed maps will be submitted to the institute. If any local government refuses to cooperate, the institute has the right to approve the version of the map it has prepared. Last but not least is the reflection of people's ideas on the maps; to approach this, regular information meetings and public hearings are held in different districts of the regions so that the public can actively participate in preserving their natural resources. After this last level the final plans comprising the 10 green categories so called "Tehran Green Reserve (TGR)" together with "Tehran Preservation Act" are submitted to the legislature for the approval.

When the maps are presented to the municipalities, they overlay the land uses on the land covers of TPI. These two data have different boundaries and have to be unified. Each of the 10 categories receives a priority number which shows its classification as well as the priority in preservation based on the quality of the green texture and the importance. Figure 7.17 shows the TGR in the three selected regions classified according to their priorities. When the natural (land cover) and the legal (land use) data want to be combined, the parcel that has a legal land use and a green land cover will be labeled as "Land use-Preserve-Priority". As an example, a residential building in the municipality maps which is partially signed as garden in TGR will be labeled as Residential-Preserve-1. This shows that the urban land use/deed can remain residential but any green part of the parcel is registered in details in TPI and has to be preserved as the first priority in the Green Archive. This requires a new point of view to land which is the multiple-use demands. One of the main tasks of TPI is to make detailed records using different aerial photos, photographs, registering the type and qualifying the green texture to be able to implement a superior preservation method. Since the parks will be mainly remaining under the governance of the Parks and Green Space Organization and according to aerial photos analysis (chapter 5) have has less destruction during the time, they receive the least priority in the table.

It should be noted that the low capability lands with lower priority are valuable to the ecological plan of the city as well. TPI follows two main goals: Preserve and create the green lands in Tehran. The second goal can only be achieved in the second phase after the institute has accomplished certain preservation objectives determined in the beginning of foundation. The low-quality lands can be effectively used in conjunctions with the prime lands or high-priority parcels. This helps the institute follow its optimal aim of designing the "Tehran Green Network" which is the base of the ecological plan. Moreover, the compatible land uses can be delineated by using these lands to prevent ruinous intrusion of the urban land uses into the high-quality green community.

Beside the first task of completing the main Green Archive of TGR, a list of the main trees in Tehran has to be prepared with the cooperation of the Parks and Green Space Organization. Similar to many successful countries in green preservation such as Germany, this list has to be ordered according to the priority of the trees. In exceptional cases that the green part of the preserved parcels has to be destructed, the local tree priorities along with TGR ones in figure 7.17 will be taken into consideration. These cases will be explained later.

Figure 7.17: The total area and the priority orders of Tehran Green Reserve (TGR) in the three selected region

Priority	Green land type	Area (m^2)
1	Garden	11,920,719
2	Farmland 1	1,773,205
3	Farmland	3,319,080
4	Farmland 2	1,456,928
5	Open Green space 1	1,751,650
6	Old Garden	470,784
7	Open Green space 2	1,930,961
8	Open space	6,294,209
9	Open Green space 3	394,560
10	Park	5,983,774

Source: Author

As the first new unique step in preservation establishing TPI will be implemented as a pilot project for the three selected regions of 1, 2 and 18. The material, data and existing information were only available for these three. Later, by having access to more extensive data, the project and therefore the institute can be extended to the entire Tehran. In the meanwhile, the deficiencies, problems and complications in the institute can be improved as well. The final goal is to have the same institute on different urban scales from local to national but this crucial step needs suitable grounds which have to be prepared during different stages. One of the most significant steps in the Iran urban planning system is to learn how to cooperate and work with each other since we all belong to one city. This has to be trained from smaller scales and when the trust is built, it can be extended to the higher scales and more staff.

7.5 Guidelines of Tehran Preservation Act (Meso-scale)[1]

Since the author is an urban regional planner, her juristic knowledge is insufficient to develop a legal act which is eligible to be approved and accepted as a PhD thesis. She is allowed and qualified to accomplish the procedure up to the end of proposing guidelines for the final act. In the further step a jurist, lawyer or lobbyist is needed to convert her goals and statements into statutory terms which can be passed in the legislature of Iran. For this step a person who has specific specialized knowledge[2] on the urban laws has to cooperate with the jurist.

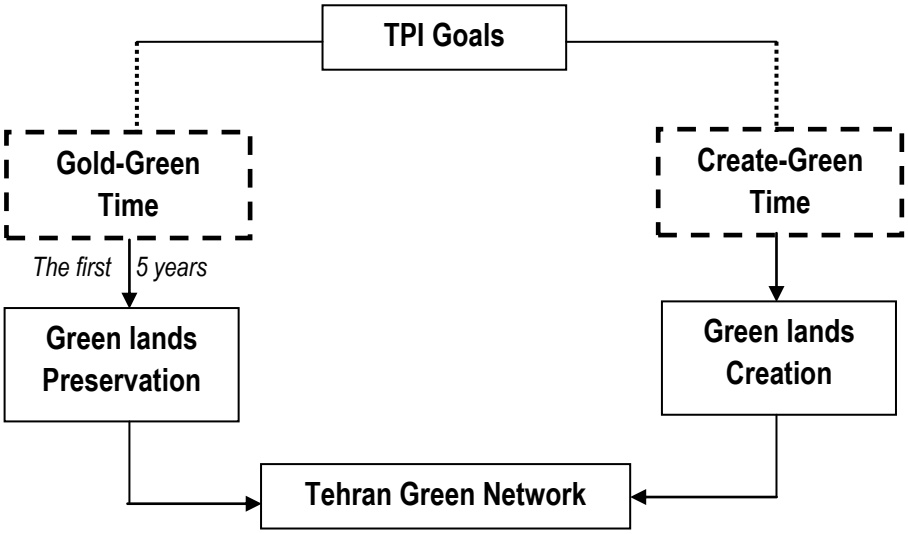
Goals: The very first goal is the foundation of the "Tehran Preservation Institute" (TPI) and defining its goals, responsibilities, sections, administration and management structure. TPI is an independent institute which covers a percentage of his costs by itself. The rest has to be covered by the national budget of the government. The main goals of TPI are in the first place to preserve and in the second one to create the green lands inside the Tehran legal boundary. For the first five years which is called "Gold-Green Time" preservation will be the only task that has to be 100% followed (Figure 7.18). In this phase the low-quality/low-priority lands will be preserved as well to be used in the second phase of "Create-Green Time". During this time by using the mentioned lands and trying to enhance their quality, the connectivity between the preserved lands will be conducted. The ultimate goal is to design a "Tehran Green Network" which is the base for the ecological plan prepared in TPI.

Garden definition: Since many garden destructions stem from the incomplete definition of garden in the Iran law[3] (Section 7.1 and chapter 4) which does not cover all the valuable green textures in Tehran, from this date the current definition is substituted with the 10 preserved green categories or TGR. By using the recent aerial photos with a high resolution, each single tree even inside the private properties can be observed. This will be the

[1] In this part the author has been inspired by the articles provided by Ms. G. G. Runka, the chairman of the British Columbia Land Commission. Ms. Runka guided the author and answered many of her questions via email. Since the articles have not been directly used here, they have not been written in the references.
[2] The author has known candidates for these people during her trips and interviews in Iran.
[3] Article 1 of the "Code of the practice of the amendment of the preservation and expansion of the green spaces" in 1980.

reliable technical tool to distinguish the green lands in any category whereas the field work has been always the basis of the previous plans. The Garden category comprises the best quality and dense trees comparing to the others. This method is not based on the legal parcels of the urban plans and does not have any size limitations as the current laws do. It is based on the land cover, i.e., any single tree and any green texture ought to be preserved due to the current urgent status of Tehran.

Figure 7.18: Tehran Preservation Institute goals



Source: Author

Regulation power: It has to be highlighted here that the success of the Tehran Preservation Act (TPA) is dependent on its executive power. It is apparent that the current laws concerning preservation are not effective enough to prevent green land loss in Tehran (Chapter 4). The revision of all the existing acts and rules is time-consuming and complicated. Moreover, if the new act comes along with the previous ones, the contradictions and unclear sides will worsen and this will provide a good opportunity for loopholes. The success can much highly be ensured when this act is the one and only reference for the preservation. Each rule concerning the green lands has to be accumulated in the TPA and all previous acts, laws, commissions, regulations and rules concerning the green lands are revoked. This does not mean that the previous rules will be ignored in the new act. The parts which have been effective in preserving the green lands during the time will be used here. The decisions regarding the green lands have to be excluded from the Commissions Code 5, 12 or 7. A representative from TPI will attend the commissions meeting to keep the consistency of the TPI decisions with the urban plans.

Consistency with the other plans: In contrary to the rules and regulations, the urban plans comprising the Comprehensive plan and the Detailed plans are valid and will fully be executed. The recommended preserved green layer will overlay each of the Detailed plans like a network. In this way, there will not be any necessity to develop any new urban plan and change the whole urban system. The new ecological plan will be added to the Detailed plan and it is easily consistent with all existing plans. The attachment of the Comprehensive plan called "The farmlands and gardens and the green valuable residential textures"[1] will be substituted by the new TPA.

Management structure: The main concept of designating the administration and management structure of TPI is to separate different responsibilities relating green preservation to make them clear and transparent for everyone and avoid parallel tasks. Then, the cooperation between the different sections and outer organizations, ministries and institutes is required to cut the costs and to be compatible with other plans/projects. According to the explained universal case studies, 20-30 staff members are enough to begin with the three regions in this research

[1] Another name for this attachment is "Preservation of the urban natural heir". In reality it is "The executive practice of article 14 of the urban land act" which is revoked due to the new TPA.

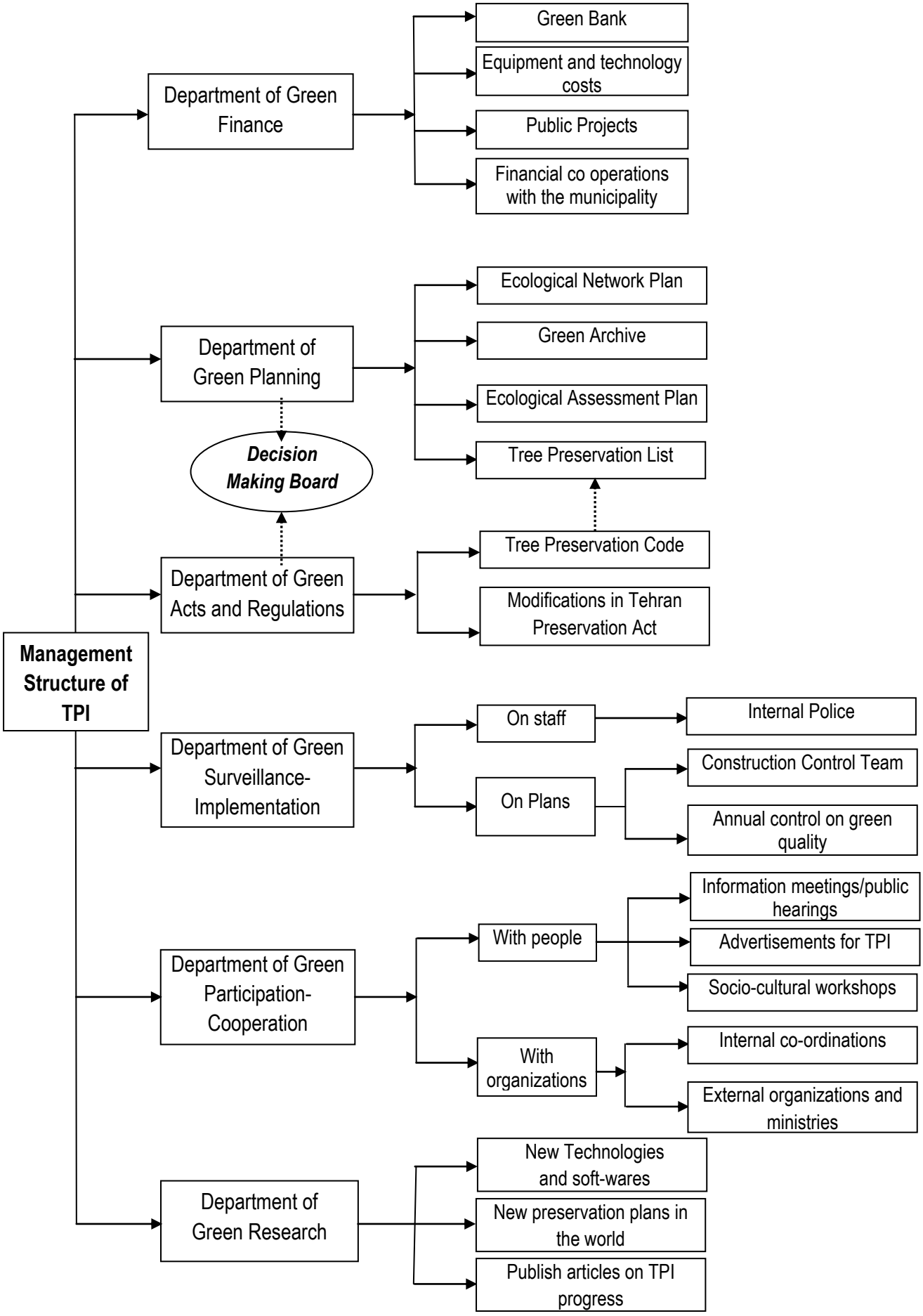
for the following sections: The departments of Green Finance, Green Participation and Cooperation, Green Planning, Green Implementation and Surveillance, Green Acts and Regulations, and Green Research. Although decision making and financial section work separately to avoid the any conflict of interests, they collaborate with each other to impose less charges on the whole urban system. The revenue is not gained in monetary terms only and just allocated to TPI but the final social, cultural, economic and health costs a decision will bring in the city in long term has to be taken into consideration. In order to keep the policy of keeping the staff to a small, close-knit working group, the main effort will be invested in using expertise and assistance of other agencies of government and municipalities. These organizations which cooperate with TPI in data exchange have been mentioned in the previous part.

As shown in figure 7.19, apart from the main board, TPI has six different departments with separated responsibilities but interconnected to each other. The first department is the Department of Green Finance which is responsible for the economic tasks and has a trust account called Green Bank. Any earning, revenue, costs, charges or benefits have to be calculated and be saved in the Green Bank. This section has to find the best prices and purchasers of the new technology/equipments that the Green Research section finds necessary for TPI. They have to work closely with the Agriculture Bank and the Tourism bank[1] to find appropriate loans/credits for TPI. Moreover, the monetary terms with the municipality will be discussed and solved in this section. Sharing the costs of the tree transplantation in the public projects between TPI and the other organizations is its other task. In the beginning and with this research size, two full-time people are enough for the Green Finance.

The second section in TPI is the Department of Green Planning which works intensively and closely with the Department of Green Acts and Regulations. All the city green plans and projects developed in TPI have to have legal basis[2]. The main source will be TPA which is comprehensive enough to cover all the juristic circumstances for the green lands. It is a progressive legislation and a component of the sustainable development in practice. However, the type of work in TPI is ongoing and evolving which will update, amend and refine the parts of act which cannot be applied well in the reality. This task is related to the Department of Green Acts and Regulations. Along with this act, Tree Preservation Code has to be prepared and modified in this section and passed by the legislature as well. The specialists in the field of green spaces and plant biologists are required to complete the tree list. The list of Tehran preserved species will be kept in the planning section and followed. The first and main task of TPI staff is to develop the Ecological Network Plan of Tehran which can only be achieved with completing and refining the TGR. This data base along with the other characteristics of the green texture in each preserved parcel will be kept in the Green Archive which is like an ID for Tehran green lands. In the next steps, when the archive is complete, TPI is responsible to prepare an Ecological Assessment Plan for the future urban plans in Tehran. This plan functions as a sustainable filter which each urban plan including the Comprehensive or Detailed plans have to go through to have the permission to be passed and implemented. The preservation of the green lands, soil/water contamination, air pollution, biological diversity, climate change, cultural and social sustainability will be taken into consideration for accepting any urban plan.[3]

[1] Currently these two banks exist in Iran.
[2] Similar to Bebaungsplan in Germany explained in chapter 4.
[3] Similar to Umweltprüfung in Germany explained in chapter 4.

Figure 7.19: Management structure of Tehran Preservation Institute



Source: the author

The Department of Green Surveillance-Implementation is the forth section in TPI. Since the implementation can only be ensured if there is a strict control on the rules and on the execution of the plans, these two have been accumulated in one department. In order to control the forbidden constructions inside the preserved parcels, the Construction Control Team has to be organized. Each member is responsible for one region. They work mainly outside the office and constantly try to update the constructions data. Since the results of the AHP model states that some land uses are more likely to be destructed, they have to be extremely taken into consideration by the team; private parcels and the public ones comprising schools, hospitals, health centers and barracks are on this list. Another team works together with this team for controlling the quality of the green lands. They have to present annual report on their investigations based on monthly basis. Besides, there is an internal police for controlling any eventual fraud or misleading in fulfillment of the tasks by the staff. It has to also survey if the decisions in the board is not based on the economic interests. It has to be noted here that when the institute expands to cover 22 regions, many regions will be representatives for the others based on their similar qualifications. Some regions have very small amount of trees too. Therefore, the number of staff will not increase dramatically.

The Department of Participation and Cooperation is responsible for the socio-cultural sustainability in preservation. In the universal case studies, sometimes up to 300 information meetings and public hearings have been held to absorb people's participation in the preserving the city farmlands. Due to the different socio-cultural characteristics of each of the three regions, it is very crucial to hold different workshops and programs according to the life style and the residents. Thus, contact persons are required to organize different events. Besides, coordinators are needed to coordinate the different internal departments in TPI and keep the contact with external organizations. Thus, the relations between the financial section and the decision making have to be conducted by this filter which works as a thwarter for any fraud as well (beside the internal police). In addition, the outcomes of the research section which have to be evaluated by the financial one has to be done through the coordinators in this department.

The last department is the Department of Green Research comprising three researchers seeking for the new technologies, soft-wares, plans and programs which can develop the preservation procedure and outcomes in Tehran. They are subject to have a sufficient knowledge of English and work as the international communication center for TPI. Designing a rich informative online website, updating news on the institute, presenting TPI to journalists, TV, NGOs and other organizations and developing the electronic tracking system for the preserved parcels have to be organized by this group. They try to investigate and find for which departments their achievements, researches, outcomes and plans might be useful. Moreover, it is expected that every 6 months they submit a scientific article concerning TPI activities and progress in the journals.

Beside all the six mentioned departments there is a Decision Making Board which is the core of TPI, comprising one member from the Department of Green Planning and another one from the Green Acts and Regulation section and a chairman. For the Gold-Green Time the chairman is preferred to be a lawyer with enough knowledge on urban rules to help submitting the plan and dealing with the juristic complications arising in the first years. This will accelerate the whole system to prepare the Green Archive as soon as possible. This is an apparent urgency and losing time means losing more green lands.

The selection of the staff is one of the most significant phases after the establishment of TPI. They have to be selected individually with two to three times interview to be sure that they are not getting the job just for making their end meet and have a social activity but rather this kind of responsibility is what they are obsessed to. They need to be dedicated, well-trained competent and have enthusiasm for the hard work with lots of challenges. It is not a boring office job at all and they have to fully grasp the essential of the tasks at hand. English knowledge is necessary to update the institute and have connections with international purchasers, preservation organizations and charities and translate the latest articles to enhance the knowledge of the staff on the new preservation policies. The young generation of engineers and urban planners are suitable for this institute. Having motivation is more important than having experience in this system. Since by establishing TPI, some sections in different organizations may be revoked, their professional staff with an exam and an interview are welcome to work is TPI

as well. The final number of fixed members to start with the three selected regions is 26. However, this number has to be completed by the part-time staff for special events and workshops inside the regions.

TPI tasks: The responsibilities of each department have been explained above. However, summarizing the whole tasks of the institute will be as follows: Preparing the Green Archive and afterwards the Ecological Green Network based on it; preparing the Tree Preservation Code and its attached list; preparing the Ecological Assessment Plan; reviewing the local government policies and plans each year to be consistent with the municipality; controlling the quality of the green preserved parcels in the Green Archive each year; surveillance any constructions in the TGR; supporting the green lands owners, gardeners, farmers and any green activity in Tehran and holding different social programs/workshops to enhance the residents' cultural knowledge on the ecological environmental issues.

Surveillance body on the TPI: Beside the internal police which functions as an internal inspection on the TPI staff, the City Council is an external surveillance selected by people. TPI is subject to preparing the annual reports on its progress to the City Council so that it can extend its budget from the government for the next year. The City Council has to ensure that after the first year of the foundation of the TPI, the Green Archive comprising the complete list of the preserved parcels with their detailed characteristics attached to them in the forms of the GIS attribute tables are prepared. In addition, TPI is the subject to hand in the list of the preserved trees for the Tree Preservation Code parallel to the Green Archive. It has to be noted that the current Iran law[1] has mentioned that the municipality has a year to produce ID cards for the trees. Since no supervision body has been determined to ensure the execution of the act, it has not been completely accomplished. Moreover, this act has been mainly passed for the public trees along the streets or in the public places; private trees inside the gardens have been ignored.

Regulation concept: The main concept behind the regulations in TPI is not to present different punishment rules to receive fines and penalties as a financial resource for covering the expenditures. It is proved that this approach has not been successful in the current Tehran urbanism. It is more focused on very clear, strict and rigorous rules which have tried to closure all the loopholes and be set in a way to discourage any construction in the green lands or any possible fraud. In contrary, the incentive policies and programs have tried to support anyone who wants to preserve his piece of land and be a part of TGR. The main idea is to minimum the costs of preservation and the consequences its construction has for the city. It does not have to be a direct monetary win in the system to be successful but preventing any further costs for the city can be defined as gaining the revenue as well. Optimizing the green land status can cut many direct and indirect costs it can bring to the human life and the city authorities. Thus, the decision makers in TPI have to take distance from the typical temporary mentality that has conquered the urban planning in Tehran. The long term consequences and the total social-economic costs a decision has for the residents and the urban system has to be taken into consideration. Otherwise, the system has to pay for the negatives outcomes of the temporary decisions in near future.

Another point which has to be clear is that the lack of the green spaces in each region has to be calculated and analyzed individually and the compensations and green lands creations have to be based on the regional scale. In contrary, the distribution of the budget is for the entire three regions[2]. There might be the regions with more potential to help other regions to provide their green land deficiency. Since we live in one city and the climate change problems and the issues caused by the lack of green lands are rarely location-oriented, the balance between green and brown lands has to be kept based on one budget. This stems from the urban social justice theories (chapter 2).

Tree Preservation Code: One of the tasks of TPI staff is to gather the exact information about the local trees which are the ecological elements of Tehran ecosystem. Similar to Germany[3] a list of exact species with the root diameter, age and other characteristics have to be developed and be under a strict preservation. In the rare

[1] Article 2 of the "Preservation and expansion of the green spaces act" of 1980.
[2] If this research is implemented in the entire Tehran, the budget is for all the regions.
[3] Baumschutz

cases that there is no other solution than chopping off the tree on the list, it has to be transferred. The data regarding this code will be kept in Green Archive of TPI.

Equipments: TPI should not just have the competent staff and up-to-date knowledge but has to have the modern technology as well. The very first capital cost that has to be invested is tree-transplanting machines. These machines have to be available at TPI to transplant the trees which have to be chopped off and are on the list of the Tree Preservation Code. Since each costs between 5000-15000 Euros, the government has to collaborate with the Agriculture Bank and TPI to import these machines with no extra tax and custom (Green-Tax-Free Act).

The second technology is effluent spray irrigation technology which is not expensive at all but can effectively help arid land to improve. TPI is subject to helping the gardeners and farmers to develop the new technologies to overcome the water problems in Tehran. Importing any equipment relating the tree preservation has to be with collaboration of custom to cut the expenses. The research group of TPI has to conduct the international investigations to find the new technologies for improving the farm or trees' yields.

Land use conversion: The current law[1] announces the land use conversion of gardens and farmlands permitted if it is according to the regulations of the Housing and Urban Development Organization. From this date, the current act has transcendence on the existing act and therefore the green land conversion is strictly forbidden.

Subdivision appeals: Currently, the subdivision of the gardens is allowed in Iran law[2]. According to the new act any subdivision has to be discouraged by the appropriate regulations. The concept of Land use-Preserve-Priority is more flexible than the preservation zones which are recommended in many plans. In this method, the whole urban parcel will not be deprived from urban development and constructions but only the green part has been looked after. In one condition the owner can get subdivision permission and that is when he agrees on donating the open-green part to the TPI. TPI has to look after this part and use it as a green connection element to design Tehran Green Network and enhance its quality. The first priority is to convert it into park. If it is converted to park, it will not go under the supervision of Park Organization. The parcel will stay in the TGR as the property of the institute with the Park-Preserve land cover. In the case that the green land part is in the two lowest quality categories of the list in figure 7.15 (parks excluded) and has more than $200\mathrm{m}^2$, the institute has the right to work with the regional municipality to locate a compatible land use[3] in the owned parcel after the subdivision. The occupancy rate is 30% in one single floor[4]. 30% of any eventual revenue has to be transferred to the municipality and the 70% will be saved in the Green Bank. The owner who donates his green part can get incentive permission of building more than the approved building density in the Detailed plan of the region. The municipality will collaborate with TPI and the owner by holding meetings. However, if the building is higher than 4 floors, it has to have the new architecture style called "Vertical Wood"[5] (Figure 7.20). If there is any tree on the Tree Preservation Code list in the green part of the parcel and TPI wants to locate a new land use in that location, the trees have to be transferred by the institute to the Vertical Wood. If the specialist state that the transplanting process will not be successful, the double number of trees have to be cultivated by the institute in the vertical wood. It has to be emphasized here that not any other green category can enter this cycle and it is allocated to the lands with low quality which likely have no valuable tree. The deep cellars/ parking lots can only be permitted when they do not destruct the Qanats currents or trees roots. Therefore, before construction of any building more than one story underground, the ecological assessment relating Qanats will be done by TPI.

[1] The article 14 of the Urban Land Act.
[2] According to the paragraph 1, article 4 of the preservation and expansion of the green spaces of 1980.
[3] The compatible land use in this context are : garden-restaurants, art and flower exhibitions and gardening museums
[4] The "Special Green Preserved Zone" in Region 2 has its own regulations which will be presented in the region proposals.
[5] Or "Bosco verticale" which is a pair of residential towers in the Porta Nuova district of Milan, Italy. They have a height of 110 meters and 76 meters and will host more than 900 trees (approximately 550 and 350 trees in the first and second towers respectively) on 8,900 square meters of terraces (Wikipedia, Bosco verticale, 2015).

Figure 7.20: The vertical wood, the new style for the buildings with more than 4 floors which get subdivision from TPI

Source: www.Inhabitat.com

Regarding the agricultural lands "subdivision may bring gains to agriculture in the short term because purchasers of the subdivided portion will bring the land into food production. But in the long run, the effect of such a subdivision may be detrimental because the smaller parcel size may discourage or reduce the likelihood of future owners using the land for full-time commercial agricultural operations" (Runka, 1977, p.139). Moreover, the connectivity between the farmlands has been one of the criteria which has influence on their destruction (the final priority weights in AHP model). The farmland zones can better be preserved than the parcels. In spite of all explanations above, in the land class 6 and 7[1] which are a part of lowest quality farmlands (Farmland 2), the limited number of accommodation for bed and breakfast, agri-tourism activities and agri-museums can be allowed with the following construction regulations[2]: 10% occupancy rate, 15% building density in 1.5 floors. The location of the building has to be decided in TPI according to the class of land. Agri-museums will be explained in the social-cultural programs. Any other construction or any sub-division is strictly forbidden in the agricultural lands.

Public projects: Any tree chopping and farmland destruction is strictly forbidden in Tehran. All the trees, public or private have been registered in the Green Archive of TPI and are preserved exactly according to the "Tree Preservation Code". The only exceptional case like many other countries is public projects such as highways, railways, ducts, electricity, telephone, power lines and gas or petrol pipes. The difference with the current act in 2008[3] is that the current one gives permission to any civil work mentioned above and any obstacle for civil engineering to cut the trees off. However, in this act the appeal has to go to TPI and this institute will try to overlay the proposed power lines on the ecological plan and reroute/relocate the lines on the farms or gardens with lower quality of the green texture/soil classification. The TPI approach is not to prevent the development but rather to find ecologically optimal accommodation for the development. At the end, any tree that has to be chopped off due

[1] These classes are presented by Canada Land Inventory (CLI) in the classification methodology for determining land capability for agriculture. Since Canada is one of the biggest exporters of agricultural products, even to Iran, this method has been proposed from CLI. Any other similar method which presents the suitable data for TPI can be substituted.

[2] In this part the recommended construction proposals in Bafte-e Shahr plan (Chapter4) have been used. The general recommendation of this company about purchasing all the green lands by the municipality and financing the preservation with the investors in the form of small projects is not realistic enough to be used here. However, the zoning process and the exact regulation amendments are a hard valuable work. Moreover, accepting the current management structure and rules with a slight modification cannot bring in effective results either.

[3] The current existing act on this subject is the "article 5 of the Code of practice of the amendment of preservation and expansion of the green spaces of 1980".

to the proposed power lines by TPI has to be checked with the list of Tree Preservation Code and if it is on the list, TPI and the responsible organization for civil work are subject to transferring the tree by using the tree-transplanting machines available in TPI. Any other cost such as labor has to be covered by the organization. It should be noted here that the technical cooperation of The Ministry of Roads and Urban Development with TPI staff to propose a route compatible with the existing roads and projects is necessary.

In two cases the transplanting is being substituted by the current Iran law[1]. Since the time the TPI does not have enough technical equipments to transplant the tree which is likely to be in the Gold-Green Time; or when the professional technicians believe that the tree cannot be transplanted successfully and will be hurt. According to the current Iran law "a tree with two times more than that root perimeter of the existing tree ought to be planted by the owner in a place ascertained by the municipality". In the new act the place will be ascertained by the TPI according to the calculations of the lack of green space in the regions. The internal police and the City Council supervise the execution of this procedure.

Ecological Assessment Test: From this date all the urban plans comprising the Comprehensive and the Detailed plans have to pass the Ecological Assessment Test before being enacted. This test is in the form of a plan prepared by TPI and can be based according to German version which is complete enough to cover all the ecological problems in Iran (Chapter 4 and management structure of this chapter).

Consistent land uses: In accommodating the land uses the problems are less than other preservation plans because the land use of the preserved parcels has not been changed or restricted according to the TPA. The owner can keep the land use and has the construction right according to the Detailed plan. The land uses allowed in farmlands are bed and breakfast, agri-museums, energy parks and agri-tourism[2] activities. Agricultural museums with a separated section for children to work with small-scale agricultural machines and instruments are extremely supported. The children can get in contact with animals and strengthen their connection to the nature. These activities are permitted only on the agricultural lands of soil type 6 and 7 (explained in subdivision). The old Iranian farming and the new modern farming industry can be exhibited with comparison to each other. It has to be emphasized here that agri-tourism can be one of the possible solutions and cannot be considered as the main financial resource for the farmers. However, based on the successful experiences of expensive cultural-educational courses for the children in region 1, it can be expected that the visitors of this program will mainly come from region 1 (Figure 7.21).

In the recommended energy parks[3] which are leisure-educational land uses adults and children can learn how the renewable energy can be generated through new technologies in the farms and using the free solar energy. The wind parks will not be suggested in the case of Tehran. For this outdoor exhibition the TPI will curiously cooperate with the founder and with the help of the "Renewable Energy Organization" the ideas can better be implemented. Beside, any new farming technology to increase productivity and the yield quality is welcome to be presented in the event. The mentioned permitted land uses in the farmlands will be supported by TPI and the Agriculture Bank

[1] Paragraph 3, article 4 of "The preservation and expansion of the green spaces act" in 1980.

[2] Agritourism or Agrotourism, as it is defined most broadly, involves any agriculturally based operation or activity that brings visitors to a farm or ranch. Agritourism includes a wide variety of activities, including buying produce direct from a farm stand, navigating a corn maze, picking fruit, feeding animals, or staying at a B&B on a farm. Agritourism is a form of niche tourism that is considered a growth industry in many parts of the world, including Australia, Canada, the United States, and the Philippines (Wikipedia, Agritourism, 2015)

[3] An energy park is a separate area used and planned for the purpose of clean energy development, like wind and solar generation facilities. Energy parks create many other economic development benefits too. In Ohio, energy parks are creating thousands of green jobs. In England, wind parks are commonly known as wind farms. Some energy parks feature additional features beyond clean energy generation. Additional benefits include: green job creation, Smart grid connections, as well as new recreational, technology innovation and agricultural opportunities. The Stamford Energy Park in Vermont is one example of an integrated energy park (Wikipedia, Energy Park, 2015).

with the fixed rate loans half of the bank prime rate to encourage the social-cultural programs for children and young people (More explanations in the programs).

Figure 7.21: The energy parks and agri-museums for kids as permitted land uses in the farmlands supported by TPI

Source: http://www.windenergyplanning.coml

Source: http://www.myagmuseum.com, www.independentmail.com and www.floridahistorynetwork.com

In region 18 which comprises factories and industries, the approach of the TPI has to be to work with the municipality to relocate new industry in the place of the old polluting factories. This has to be with the optimal economic sustainability which requires the support for the workers and the local residents' professional life. The new industries have to be in the direction of agriculturally oriented ones and complete the agricultural procedure of the adjacent lands. Mainly food and dairy products are the targets of the TPI. However, the factories working with the sand mind are inevitable.

Finance: Although preservation needs a financial base, TPI vision is to become economically dependent till 2030. In the beginning during the Gold-Green Time which is the first 5 years he has to be supported by loans and credits from the Agriculture Bank and the Tourism Bank to hire its staff, purchase the required instruments and techniques. However, as explained before, keeping the small-size staff and data exchange with other organizations is the base for cutting many expenses. TPI can in this way cover 20%-30% of its costs on its own after the second year; the rest will be the separate budget from the government. If the government does not want

to pay more for people's health care and hospitals, closure of schools and organizations, air pollution consequences, climate change and water problems, floods and different storms such as dust storms, he has to cut his costs by investing in the source and not just investing in improving the negative outcomes. This procedure has to be stopped before it raises the thresholds which cannot be controlled and compensated easily by money and extra budget[1]. However, TPI vision is to get 10% more independent each 5 years.

The new tax system from the high-income people, who Harvey calls developers-speculators, are one of the main financial solutions. The garden owners or the farmers cannot be the subject of more pressure, since they endure enough pressure from preservation system and their constrcution rights. The right social targets have to be found who gain the considerable revenues from building and they are the main people who have to be taxed according to social justice debates in chapter 2. The second new tax-payers are the high-rise residents for taking the right of light, air, view and green space from the neighbors and adjacent buildings. A share of these taxes will be gathered in the trust account, Green bank for green preservation by TPI.

TPI needs to have an extensive advertisement to get more support from different parts of the society. In Iran many charities are more on personal base and less organized; this means that they are in the form of rich single person who donates a piece of land or invests in a project which has public interest. Many of the well-known organizations are not supported by official budgets but more with the human/religious intentions of the affluent people. One of the tasks of the Department of Green Participation-cooperation is to work with the research team to advertise TPI and find supportive residents. In this case the socio-cultural programs have to work very well to make green preservation as a public interest achievement which is adorable and appreciated by the whole society. Besides, the cooperation section can represent TPI to famous international and national companies/factories and ask them for the supportive collaboration as follows[2]: if they financially support TPI, their company will get incentive taxes formulas for their annual taxes. These companies can be advertised in the city for supporting TPI and being a part of the ecological-green activities. Here, the city has to collaborate with TPI in giving the free promotion billboards in the highways and the public transport stations to the advertisements allocated to the green company and announcing its name in the train stations and public places. This will not bring in considerable monetary charges for the city but will turn back an enormous support for TPI. The billboards will be designed by the Department of Planning in TPI to cut the extra graphic charges.

Apart from application fees which cannot be considered as the cost covering, agri-tourism, agriculture museum and the energy park projects which have been explained before can be developed by the Tourism Bank and the Agriculture Bank. The green donations explained in the management structure can be a noticeable capital for TPI, either to propose new small projects with the sponsors in it or as potentials to work in TDR procedure as the green lands with very low quality. Moreover, a well-organized TDR can bring in sufficient revenue and cut many charges that it has to endure to preserve the green parcels and make the owners content for their decision on preservation.[3]

Feasibility of TDR: TDR will not be one of the most effective and the main tool used in the new preservation system. This is due to the Land use-Preserve-Priority method in which the owner has the right to develop his parcel. TDR can only be partially implemented in two cases; the first one is when the municipality and TPI cannot build a consensus on the incentive building densities for the person who donates the preserved part of his land. In this case the owner has to get this extra building density in another appropriate land for the development. These lands have to be selected from the Land Reserves of the city or municipality properties in the Gold-Green Time. TPI will rarely have any property to present to the owner as the compensation in this period. However, with more

[1] An example is currently being experienced by dust storms in the south-west of Iran which needs couple of years to be removed. The problem is so severe that it has decreased the horizontal visibility to less than 1000 meters and all the private and public hospitals have to be free for people's use and therefore paid by the government. Moreover, the schools, universities, and governmental offices were all called off.

[2] Currently, this kind of financial support is being implemented in Germany.

[3] Refer to author's master dissertation for the detailed TDR calculations and performance; Arjmand, .P., "Transferable Development Right Approach in Land Use Planning, Case Study: Niavaran neighborhood, Tehran, 2011"

donations and the land exchanges in TPI system, it is expected that it can use its own properties from the Create-Green Time which is after the first 5 years. The second case for using TDR will be when there is an appeal or special complaint which has to be discussed in the Decision Making Board or at the next level in the court. It can be possible that an owner considers himself as a person aggrieved by the TPI decisions, can prove that his rights of construction have been unfairly limited and he has not been considered individually in TPI researches. TPI will try to have several meetings with this owner and enhance the people's trust and participation and their emotional connectivity to the institute.

Annual supervision: TPI controls the TGR every year and compares the quality and quantity of the green lands registered in the Green Archive with the previous year. According to this act, it is obliged to have enough information on green land maintenance. In the case of any green degradation in both quality and quality, the staff presents the owner to TPI. If the problem stems from irrigation, TPI will help the owner to solve the water problems. Any other reason which is caused intentionally or unintentionally, directly or indirectly by the owner has to be solved as follows: The owner has to cultivate the double number of the destructed trees on a place that TPI determines. In the case of agricultural lands or other categories, the owner has to cultivate trees in an area which is double the size of the destroyed land. The owner cannot sell his property before TPI confirms that he has cultivated the trees.

Hierarchical preservation: The Tehran Preservation Act is presented here as a pilot for the three regions; by achieving the main goals in a certain period of time and after improving the eventual malfunctions and mistakes, it can be extended to the entire city of Tehran. However, the selected regions are the representatives for the other regions and the remaining regions have considerably less green lands. Therefore, less work will remain after accomplishing the selected regions. The optimal form of hierarchy is the existence of a similar institute in the form of offices in small scale on the neighborhood scale, district scale and going on to regional scale and then in the form of organizations on the city scale, provincial scale and the national scale. The cooperation between these authority levels guarantees the power of preservation and has been successful in many countries in the world (Chapter 4).

Supportive programs: "In managing the Agricultural Land Reserve, the commission is constantly concerned about the real effect of its decisions and actions on the farming community and society in general. It is not enough to preserve the land. Land is only part of the team. If we do not work also to preserve the expertise of the farmer and protect the sense of identity, self confidence, and vitality of the farming community, the whole philosophy of preserving agricultural land may well be useless" (Runka, 1977, p.140). The general explanation regarding the programs will be presented here; however, the more specified description will be discussed in each region.

Farm Income Insurance is the first program helping the farmers keeping their lands; there is a difference between this program and the ones implemented in the universal examples (Chapter 4). In the international cases the governments will provide the farmers with payments when return is below the costs of the production levels. In the Iranian version the farmer will be rewarded with payments if he manages to product more than the level that the TPI staff along with the Ministry of Agriculture determines. Apart from an award he will be provided monthly with 20% of his average gross income/sale (before cutting the costs) in the coming year. In very well-performed cases the farmer can benefit from the opportunity the municipality gives him to present his products directly once a week in the fruit and vegetable markets of the regions. His place can be signed as the "self-sufficient Iranian farmer awarded by TPI" to appreciate the farmer's work and make stronger connections between people and the urban farming through TPI. This procedure can only be successful if the Fruit and Vegetable Organization who belongs to the municipality of Tehran cooperate with the TPI. The current international version of this program might be misled and make the farmers passive and decrease their motivation in working full-time on the farms. Thus, the farmlands may lose their quality or be destroyed at the end.

Agricultural Credit Program which has to be passed as an act in the legislature of Iran. It is on one side specialized for TPI to get fixed rate loans at the half of the bank prime rate. In some cases it may give grants to establish the institute, implement its green projects, purchase its new equipments and technologies and preserve more green lands. On the other side, under this act limited guarantees have to be given to the banks for loans

they make to the farmers/gardeners. The award mentioned in the Farm Income Insurance will be provided by this program. This means its target has to be on one hand to support TPI projects and financial issues and on the other hand to present the financial support for the green land owners. The agricultural museum, energy park and agri-tourism projects which can be in from of cooperative projects with the owner can be partially financed by this source. The Agriculture Bank, the Tourism Bank and the Renewable Energy Organization of Iran are the three target groups which can be effective in the success of this program.

Green Custom-Free Act is an act which has to be passed to help the national farming industry to flourish. The technical instruments, agricultural machines and industry required in TPI to improve and ease the preservation process has to be imported to Iran without any extra tax or with very small tax payments. It has to be noted that such appeals have to be first researched, surveyed and studied by the Department of Green Research and be submitted to the Department of Green Finance. At the end, the necessity of purchasing the industry along with the reports from these two departments has to be discussed in the main board of TPI.

Green Schools Program: Since TPI has to work on children and new generation as the sustainable future supporters of the urban ecology, cooperation with the schools can be an effective way to make progress in socio-cultural programs. The schools which sign up the farmers and the farm owner's children with 50% discount on their tuition fee can use TPI agricultural museum for kids with a considerable discount. In addition, these schools can have regular visits organized by the TPI for agri-tourism and leisure activity projects of TPI in green lands of Tehran with fewer fees and enhance the eco-cultural knowledge of the children. However, TPI has the task of presenting itself with workshop in all schools and promote the goals it intends to achieve. These workshops will give the priorities to these schools.

Incentive Density Program: Beside the mentioned programs for supporting farm owners, other green land including gardens will be supported by the system explained in the subdivision appeal. In contrary to the farms with very strict building permissions, gardens have the natural right to build in the exact occupancy rate they have built till now. In addition, they have to follow the building densities presented in the Detailed plans of 2006. However, the green part has to be preserved strictly according to the ecological network plan and the priorities. If the owner donates his green part to get the division permission, he can get the incentive building density more than the approved density in the Detailed plan for his share. The municipality cooperates with TPI and the owner to protect the idea of donating green lands without selling density or investing money. This has been also mentioned in the current Iran law[1] which states that the City Council has to present the incentive policies for the limited constructions in the gardens. However, in the buildings with 4 floors and more the "Vertical Wood" style has to be strictly followed.

Retirement program: The Agriculture Bank has to develop a new beneficial conditions and special farmer pension for the retired farmers. This is the subject of the Retirement program. Besides, TPI has to be in contact with the old farmers who cannot continue keeping their farm and their children intend to continue their father's job. In the first step, TPI tries to motivate the children with the creative incentive programs and the supports; if they are not convinced, TPI comes in the middle and negotiate with the owner and the sponsors, organizations and governmental departments to buy this land. The institute makes its very best to find the best buyer with high preservation intentions for the land and also collaborates with the municipality to prepare a compatible multi-purpose land use in this area that is becoming fragmented. The goal is to make the land interesting enough to serve the interests of the agencies or buyers but simultaneously avoid any threatening owner to enter the cycle.

Green Jobless program[2]: For any construction and easy civil work of making parks and designing the landscape, TPI hires the poor roofless beggar poor people in Tehran based on the minimum daily wage. The limit and the consequences have to be discussed with the Ministry of Labors, Social Affairs, Martyrs and Disabled.

[1] Article 12 of "The code of practice of the amendment of preservation and expansion of the green spaces of 1980".
[2] This program has been implemented successfully in Bürgerpark Haarzopf of Essen, Germany.

Water Protection program: In the existing acts of Tehran[1] the irrigation and looking after the trees have been announced as the responsibility of the owner but in the current situation the accessibility to water supplements is the main problem. As currently this problem is one of the reasons of the garden conversions (results of AHP model), TPI has to cooperate with the Tehran disaster Mitigation and Management Organization (TDMMO) to have the optimal use of Qanats water. TDMMO has been recently appointed to prepare the Qanats map and register their current status. This collaboration has to find the best way to have a time-schedule for the gardens and farmlands according to their priority to conduct Qanat currents for the regular irrigation. TPI research section has to work on new technologies to separate the drinkable and irrigation waterlines to be used for the green lands. Using the underground waters have to be further studied. The Tehran Province Water and Wastewater Organization has to be an active member of this cooperation.

Green Tax Program: TPI need a separate tax closed system which is based on the social justice theories and the residents' rights in the city. The closed system is to use the taxes directly for preservation. The idea of sell density is to give extra density and then use the money to compensate the space, air, green space, view and privacy which have been taken by other residents. This is done by making green spaces around the high-rise. This right has to be received in the form of tax from high-rise residents. The second part of this system is a new tax formula for the developers-speculators. A percentage of this tax has be the saved in the Green Bank for the preservation. The rest remains for the municipality.

Socio-cultural programs: Since these programs are strongly dependent on the socio-economic and local characteristics of each region, they are presented in the regions separately. However, they all pursue one single goal which is to improve the gradual disconnection of the residents from the urban green ecology.

7.6 Proposals in the regions (Micro-scale)

The general aims on the macro-scale have been developed in the four dimensions of the theoretical basis (Sustainable development). Thereafter, the guidelines to the TPA have tried to simulate the details which are in common in all the three selected regions and have been considered as the Meso-scale suggestions since they are not as general as the aims. The micro-scale proposals are presented in each region according to their local characteristics. In order to develop the proposals in each region, first a comparison analysis between the three regions' main socio-economic, cultural, urban and ecological characteristics will be reviewed. Figure 7.22 has been derived from chapter 3 and 5. The related maps have been presented in chapter 3. The analysis presented in the figure shows that the three regions have very different characteristics and in addition to a general preservation act for the whole Tehran, each region has to have its own socio-economic and cultural regulations based on its residents' characteristics. Without people's participation any act approval cannot be successfully implemented.

Region 18 has traditional residents, with more economic problems, unemployed rate, less literacy ratio and highly-educated people, higher dependency ratio and much lower social capital quality than other 2 regions. The statistics in this region comparing to the rest 22 regions of Tehran show that this region is almost at the end of the list in Tehran scale as well. Most of the jobs in this region are in the first place assemblers, operators and vehicle drivers and in the second one health and social workers. The land price has the lowest rate among the three regions which reflects the financial problems of the farmers too. However, the statistics from 1995 to 2010 show that the building permission have increased dramatically in this region and region 2. They have the highest number of building permissions in 2006-2010 in Tehran whereas Region 1 has the highest numbers of permissions for buildings more than 10 floors in 2000-2001. Relating the ecological organization, it has no recreational park, very low open public spaces and green spaces and almost no valuable or rural historical texture. It has a high number of cardiovascular admissions in hospitals caused by air pollution and in total the quality of life is very low according to the official studies of Tehran municipality. The Detailed plan studies in chapter 5 show the lack of green space in this region. The positive point which can be useful in this direction is

[1] Article 14 of the Urban Land Act

that this region has the relative suitable surface area of the urban reserved lands in the range of 3% to 6% of the total area of the region. These are the free lands with non-private ownerships which have the best potentials for infill green development in this region. The Detailed plan has not considered the enormous surface area of the farmlands in its last proposals. Many of the farmlands have been ignored by proposing M, S or R zone on them. This has to be improved in the final act/regulations of this research. Moreover, the geographical situation of Tehran and the south-west wind have reduced the CO pollution distribution in this region which is a positive point among all the problems and deficiencies mentioned above.

Region 1 with the lowest average size of households is less traditional but family-based. Due to the high land price and rental costs it has the lowest number of immigrants compared to the two other regions. It exhibits a high rate of employment and people who work or study. Literacy ratio and highly-educated people have the highest statistics comparing to the entire Tehran. The main jobs are highly-qualified academics in the first place, occupational affairs in the second and legislators and administrators at the third order. The number of the employed women is high but not as high as region 2. This stems from the high economic status of the residents which do not have financial needs to let the woman work outside of the home and does not mean that she cannot work outside (explained in chapter 5). These characteristics give region 1 the highest social capital in Tehran. Concerning the urban-ecological qualifications, it has three recreational parks, the largest area of urban reserved lands (6-12%), valuable historical texture (7-15%) and valuable rural texture (19%) among the three case study regions. Since the mentioned statistics basically comprise green lands, this region obtains an extra value for preservation. The green lands have the historical background which cannot be created once destroyed. Nevertheless, it has the highest percentage of built-up area and the ratio of built-up to open space. This fact proves the high construction speed and the dense urban texture of the region. CO Pollution distribution is lower than region 2 and almost similar to region 18 but the total mortality, cardiovascular and stroke admissions in hospitals are higher than other three regions. The Detailed plan has focused mainly on the tourism function of the gardens to create a financial resource to preserve them but it has not presented enough regulations beside this function to keep the gardens while using them for the tourism land use. Despite the strong status quo study in this plan, recommendations for green lands have been limited to the big parcels as the unchangeable land uses and the entire green network comprising all small gardens has been ignored. In the Development Pattern of region 1 it has been tried to regulate the constructions in the gardens but as explained in chapter 5 these rules have caused more green lands' destructions in the region which have to be prohibited in this study. Summarizing all the mentioned indicators, region 1 has the highest quality of life in the entire Tehran.

Region 2 stands almost in the middle of the two extreme regions of 1 and 18 when comparing the socio-economic and cultural indicators. Most of its characteristics stem from the immigrants; it has the highest rate of immigrants who mostly move to study in Tehran and as a result the lowest married couples. The main jobs are very near to region 1 and it has more employed women than this region. However, there are not as many highly-educated people as region 1 living in 2. Land price is higher than most of the regions of Tehran but not as high as region 1 and 3. In general, the social capital quality is in the middle range between the two other regions. Regarding the spatial-ecological organization, it has two recreational parks and the highest percentage of open space; therefore, the ratio of the built-up to open space area is very low. It comprises more valuable historical texture than region 18 but much less than region 1. The valuable rural texture districts with 11.4% of the total area are concentrated in the north parts along river-valleys where the garden zones are located. The Detailed plan has focused on the amount of green lands which have been destroyed in this region. The main emphasis is on the north where valuable rural areas concentrated. It has also tried to highlight the socio-cultural contradictions stemming from the high number of immigrations to this region. The rapid urban development to respond the immigrations requests can be the reason of the extensive green land destructions as well. Relating air pollution indexes, CO Pollution distribution shows the highest rate but respiratory admissions in hospitals are lower than others. All in all, Region 2 has the second rate in the quality of life among the three selected regions.

Figure 7.22: The comparison analysis of each region's characteristics to develop the proposals

Nr.	Characteristics/Indicators	First rank region	Second rank region	Third rank region	Explanations
1	Average size of the households	18	2	1	East of region 1 and north of region 2 have bigger household size than average. The north-east of region 18 has smaller size than the average.
2	Population density	18	2	1	Region 18 has different densities according to the activity zones. Industrial zones have the least and residential the most in the region and among the three.
3	Migrants	2	18	1	The southeast of region 1 have lower prices and more immigrants. Most of the immigrants of region 18 have moved to farmland zones which can be the country side farmers. North part of region 2 has been quickly developed in the recent years and has the most immigrants.
4	People, working and studying	1	2	18	This indicator shows the social level of each region.
5	Ratio of married people	18	1	2	In region 18 this indicator shows the traditional background; whereas in region 1 the family-based culture. Region 2 has many immigrants with education intentions, therefore less married ratio.
6	Rate of divorced single people	1 ≥[1]	2	18	This indicator can complete the previous one.
7	Literacy ratio	1	2	18	This and the next complete the social status/level data.
8	Population with higher education	1=	2	18	There is a big gap between region 18 and two others comparing the percentage of this indicator.
9	Employment rate	1	2	18	Presents the economic status.
10	Employment women	2	1	18	As explained in chapter 5, a big amount of the unemployed women in region 1 do not have the financial reason to work.
11	Unemployment rate	18	2	1	Complete the two previous indicators.
12	Dependency ratio	18	1	2	This ratio depends on employed/unemployed people rate.
13	**Social capital quality**	1	2	18	This indicator is the result of the first 12 socio-economic and cultural indicators. Region 1 is "exactly suitable" with one district signed as "suitable". Region 2 is "exactly suitable" with two "suitable" districts. Whereas region 18 with an enormous gap is exactly "unsuitable" with one district "unsuitable".
14	Land price	1	2	18	The gap between the land price in region 1 and 2 has decreased in the recent years.
15	Urban reserved lands for urban services	1	18	2	This indicator comprises non-private ownership fallow lands, open spaces, ware houses and old factories. These lands are the best potential for compensating the destroyed green spaces of the city and are to be used in Ersatzflächenpool or TDR to keep the balance between the green and the built environment.
16	The number of recreational parks	1	2	18	Region 1 has three, 2 has two and 18 has no recreational park.

[1] This symbol shows that region 1 is almost the same as region 2 and the difference is very small.

Figure 7.22: The comparison analysis of each region's characteristics to develop the proposals (continued)

Nr.	Characteristics/Indicators	First rank region	Second rank region	Third rank region	Explanations
17	Open public spaces, green spaces and streets	2	1	18	Streets cannot be included in this group and due to the wide American types of streets mainly in the north part of region 2, region one has the second rank. In addition the quality of open space is quite different.
19	Percentage of the open public spaces, green spaces and streets)	2	18	1	29.8% of region 2 is open space whereas 27.9% of region 18 and 25.9% of region 1.
20	Relation of built up to open spaces	1	18	2	This rate is 2.9 times in region 1, 2.6 times in region 18 and 2.4 in region 2.
21	Valuable historical texture	1	2	18	There is an enormous difference between region 1 and other regions considering this indicator. Region is in the range of 7-15 % whereas region 2 has 1-2% and region 18 comprises 0-0.5% of valuable historical texture. In the most cases the historical parcels are the green parcels too and this enhance the value of preservation in this region.
22	Valuable rural texture	1	2	18	Region 18 does not comprise any valuable rural texture. Almost 19% of Region 1 belongs to this texture which is green as well. Region 2 stands in the middle with 11.4% which is concentrated in the north part of it.
23	CO Pollution distribution	2	1=	18	Due to the geographical situation of Tehran, wind direction and the location of mountains explained in chapter 3, the concentration of CO in region 1 and 18 are almost similar to each other.
24	Correlation between pollutants and *cardiovascular* admissions in hospitals	1	2	18	
25	Correlation between pollutants and *respiratory* admissions in hospitals	18	1	2	There is an enormous difference between region 18 and others.
26	Correlation between pollutants and *stroke* admissions in hospitals	1	2	18	
27	Total mortality	1	2	18	
28	Quality of life	1	2	18	Quality of life is the overlay of all the characteristics mentioned above. Region 1 has the highest rate in the entire Tehran.

Source: The author

7.7 Proposals in region 1 according to the priority weight

In region 1 the planner is confronted with a different social level than in all other regions which can be a good target for the specialized programs and projects. The proposals are arranged in the order according to their influence on the green lands destruction (AHP model results at the end of chapter 6) and have stemmed from the macro-scale proposals in the four modified dimensions of the sustainable development. Some of the criteria are more general to be specified in the regions and have been elaborated in the macro-scale proposals or the Meso-scale guidelines; therefore, they will not be repeated here again.

The most important criterion which can be modified to preserve the green lands in region 1 is to add extra value to the green lands to reduce the gap between the green and the buildable land. All local green lands of region 1 which are gardens, old gardens, open green space 1 and open spaces are included (Chapter 5). This is the third important criterion among 62 with 0.059 importance rate in the AHP model results. When a parcel Land use-Preserve-Priority in the ecological plan wants to be purchased, its legal deed determines its current value in the market and the "Garden Right" is the extra value which is decided in the TPI according to the type, quality, location and priority of its green land in the Green Archive. This will discourage the developers-speculators from investing in every little garden and when they invest the revenues cannot be as high as they are now. The better the garden, the higher the right and the less likely they can be purchased by the developers. This system will automatically preserve the high quality green lands.

Green Tax Program, Water Protection Program and Incentive Density Programs are the effective economic programs to support the gardeners and garden owners and have been explained in the guidelines to the act. They have the 14th rate in the AHP model with 0.026 weight of importance.

It is written in the law that barracks have to come under the supervision of the municipality but still this has not been executed. The necessity of implementing this act is very high for the entire Tehran and especially region 1 with the big green barrack parcels. In The AHP model it has the 36th rank as well. They are being destroyed and till this act is not executed it is hard to have any supervision on them. Barracks can be a new source of revenue for the municipality. Military museum, sport complexes and other leisure land uses can be located in these parcels. In Region 1 they comprise very high-quality green texture and therefore TPI has to be the surveillance body/ inspector on any new activity in these parcels. With the cooperation between the municipality and the TPI, the activities will be determined according to the present condition/location of the buildings and the green space. No construction is permitted in these parcels and the existing building can be reformed to suit the intended land use. The occupancy rate has to remain the same and the location of the buildings cannot be changed. This means that more internal architecture will be required.

In order to follow the main suggestions of the Detailed plan for the region 1 which is mainly based on tourism approach, the donated parcels explained in the guidelines can be used as leisure-tourism land uses. TPI tries to combine the leisure land use with the preservation concepts and sustainable development debates for the different ages. Bio restaurant-museums[1], gardening-museums for kids, cinema-park, cultural parks, flower exhibitions and art exhibitions. The gardening-museums show the children how to cultivate their own flowers/plants and take care of them. They learn about the local trees and nature of the region in practice. These ecological-cultural programs for children are extremely welcomed by the parents in this region. The museum tries to turn back the children's disconnection with the nature. The exact details of the activities are to be determined by the TPI staff according to the soil classification and the quality of the green land.

Regarding the generation change of the green lands' owners and when their children intent to build the parcel, TPI comes as the middle institute to convince the children or at the second step negotiate with the suitable buyer.

[1] The experience of Dr. Hessabi restaurant-museum with the expensive prices in region 1 has shown that this concept can be very successful in this region. This museum which is located in his home-garden is a collection of some of his personal belongings and communications with various scientific cultural figures and is established by his family, colleagues and students in order to value his 60 years of scientific work for Iran.

This has been explained before. Apart from this proposal which can be used for all the green lands, region 1 requires the socio-cultural programs which are relatively important on the final criteria list. The programs are the response to the generation change, local tradesmen, private owners, new rich, upper middle class and the lack of NGOs which are distributed all from 30th rank to the 58th but closely interrelated. The socio-cultural complementary programs in region 1 are as listed below:

Park-Participation Program[1]*:* In this program the residents of each neighborhood will be a part of designing and landscaping the park. They help to irrigate the flowers and decide for the plant types and check the trees and plants to be sure if they need any fertilizer. They are educated by working beside the people working in the park and by learning the details can participate more actively. Any age is welcome in this program. This program starts from small local parks and can be extended to the regional parks.

Green-Point-Meeting: This is the point in the parks that every first Friday[2] of the month TPI presents its institute, progress and plans. The Department of Green Participation is responsible for these meetings. They try to explain the importance of the green lands in Tehran, the ecological state of the region, the details on Tehran Preservation Act with simple words and how to support the institute. At the end any question, commend or complaint will be registered by the staff. In the coming week "Green-Point-Discussions" will be held as a meeting in the TPI Decision-Making Board to reflect people's ideas in the policies.

Shemiran[3]*-Dignity Seminars:* These seminars are mainly held in Niavaran Cultural Center which is one of the most effective and active places in the region. The old local residential, urban planning professors, urban planning university students and the high school students are welcome. However, TPI will find the old local residents to deliver a speech about their memories about how Shemiran looked like 40, 50 years ago. The author knows certain university professors who have mainly worked on this subject and can complete the memories with scientific facts, figures and slides. The whole meeting is coordinated by the young university students who are studying urban planning, archeology or any related field of study. These seminars are held each month with the cooperation of one university. TPI organizes the time table and sends its representatives to the universities working on the related subjects.

Owner Meetings: Every two months TPI invite the owners of the big green parcels which have more priority and explain the TPI progress of in the technical terms. This is more technical-specialized meeting than the Green-Point Meeting because the audiences are the owners. Their rights will be clearly explained and the new policies will be shared with them. They have the right to give their ideas on the approach, plans and guidelines of the TPI. Gradually the "Green-Owner-Board" will be formed from these meetings which comprise the most active members who want to be involved directly with the preservation procedures in TPI. The TPI will mainly be in contact with this board to participate with the owners. One of the ultimate goals is to organize preservation NGOs from all the meetings mentioned above.

TPI at Schools: TPI has special presentations for the schools. The content of the presentation is according to the age but the main goal is to educate children and teenagers about the importance of the nature, urban ecology and history of the region. After the presentation a drawing, story writing, collage or poster competition will be held with the subjects regarding green lands. The whole collection of posters and drawing will be used as an internal design to decorate the TPI building.

TPI at Playgrounds: TPI works closely with the Parks and Green Space Organization to present its meetings mentioned above in the parks and to promote TPI for children in the playgrounds.

Green Women Community: According to the socioeconomic studies women in region 1 are mostly educated but the number of employed women is lower than region 2. The housewives are very active in the cultural and sport activities. There are women sport teams doing exercises every morning in Niavaran or Gheitariye Parks, the two main old parks of the region and can be very effective in TPI process. They care for nature and healthy life. TPI

[1] This program has been implemented successfully in Bürgerpark Haarzopf of Essen, Germany.
[2] Fridays are holiday in Iran and Friday morning is often the time for all the local residents to walk in the parks in region 1.
[3] The old name for the main part of region 1 (chapter 3).

will be promoted in the parks among these women and will announce that any woman in region 1 can participate in the Green Woman Community which is a kind of NGO pursuing the preservation goals. In TPI at Schools, workshops and gardening museum this community members can effectively help TPI staff.

People-Projects-Tehran Gathering: Every 6 months the outcomes of the collaboration between TPI and the municipality will be presented in this gathering. At the end people have the right to vote for the new projects and give their ideas. This will be the basis for the social-cost-benefit survey for the urban projects.

International workshops: When TPI finds the international NGOs, charities or organizations who intend to support TPI, the international workshops will be held. The MesoCity Tehran workshop in 2012 which was about the Qanats in Tehran was a successful cooperation between the University of Tehran and the Ecole Spéciale d'Architecture of Paris. Such workshops have to be repeated more concentrated on the green lands preservation in Tehran.

7.8 Proposals in region 18 according to the priority weight

In the very beginning the green category maps developed in this research have to be sent to the Soil and Water Research Institute in the Ministry of Agriculture and other mentioned organizations in the act. The soil classification maps will be overlaid on the existing maps to refine the type of farmland and add the soil type beside the categories. The farmlands may then increase to more types according to their quality. Since region 18 is the representative for all farmland regions (Chapter 5), most of the proposals for this region have been stated in the guidelines for the TPA. However, due to the interrelated policies which will be explained here, the repetition of some proposals is inevitable. The proposals in this part will be presented according their importance in the green land destruction (Chapter 6).

In order to discourage the land speculation on the farms and stop the increment building permission in the region, from this date any construction and subdivision on the farmlands of any kind in Tehran is strictly forbidden. This is only one exception and that is when the small agri-tourism projects, bed and breakfast, agri museums and energy parks are intended to be constructed in the land class 6 or 7 (low quality farmlands). In these cases the TPI together with the municipality and according to the soil classification maps will determine the best location of the buildings with maximum 10% occupancy rate, 15% building density in 1.5 floors.

Agri-tourism and agri-museums are one of the new projects for the farmers to keep their farms and use its multi-purpose land use to cover some of their annual expenses. It is so highly supported by TPI that if the owner of the high-quality farms wants to participate in such projects, TPI will come in the middle and try to use TDR tool to conduct the project, using the low-quality lands. This means that TPI will try to link the owners and make a cooperative project but just on the condition that the location of the buildings is on the farmland 2 and determined by TPI. The possibility of the cooperation with the Iran Cultural Heritage and Tourism Organization has to be highly considered.

"From a business standpoint, agritourism can play three basic roles for the farmer: As a *supplementary enterprise*, agritourism supports the farm's primary role as a farm. The production of goods and commodities still generates most of the income while agritourism, like dairy offering tours to school groups, provides a little on the side. As a *complementary enterprise*, agritourism and traditional agriculture provide relatively equal profits to the farmer. An example of this would be a pumpkin farm where half the crops are sold to a wholesaler (who then provides pumpkins to supermarkets), while the other half are provided to paying guests who participate in a farm fall festival or jack-o'-lantern carving contest. As a *primary enterprise*, agritourism takes center stage on a farm. Any wh*olesale trade supplements the agritourism business. An example of this would be an apple farm that makes* most of its money from guests paying to spend a weekend there, but still sells some apples to wholesalers on the side to boost profits" (howstuffworks, 2015). The above attempts are the respond to the 11th criterion of AHP model which states that the value of the agricultural lands is low and that encourages the constructions.

Agri-Kid-Tourism Program: As Agritourism gives farmers the opportunity to educate visitors about their way of life and share their agricultural heritage with others, one of its main targets has to be the children. This program

should not just be limited to the region 18 but all the regions have to participate in it. TPI will make a list of the schools and their priorities according to their green lands and socio-cultural status to implement this program. The small fee will be charged for one day visit of the children. This fee is according to the economic status of the region as well. The schools which have been a part of the Green Schools Program explained in the guidelines will have extra conditions and more regular visits.

Financial guidelines of the municipality as the 12th criterion is that it often does not allocate the properties it owns to the urban projects. This can be compensated in region 1 with TDR, people's participation in donations and the other organization participations. However, in region 18 the situation is alarming; the Detailed plan has stated the lack of green space; there is no recreational park; it comprises almost no valuable or rural texture (chapter 3) and the cardiovascular admission due to the air pollution is higher than two other regions. This situation alarms that the region requires an urgent green open space in the first steps. The positive potential which can be used in this case is the urban reserved lands which are relatively high in the region (3%-6% according to chapter 3). These are the free lands which do not have private ownership complications. If the municipality cooperates with TPI and the Park and Green Space Organization, one or two parcels can be selected according to their juristic problems, location and soil texture to create parks/green open spaces in the region. As mentioned before, the green land deficiencies have to be balanced according to regional boundaries whereas the monetary terms will be discussed in the entire three regions. If this first alternative is not successful, TPI is ought to start negotiating the owners of the Green Open Space 3 parcels and then low-quality farms to convert one or two parcels into the parks. The new created parks have to be multi-purpose to fulfill the socio-cultural tasks of TPI as well. Moreover, the long term goal in the Green Open Space 3 parcels is to convert them into the parks and cultural centers with the Parks and Green Space Organization.

The 14th criterion of the AHP list is the financial issue of the farmer/owner to keep the garden. This plays an even more important role in the case of agricultural lands than it does for the gardens and increases the farmers' participation and motivation. Relating this criterion several programs have been offered in the guidelines to the act; the Retirement Program, the Agricultural Credit Program and the Farm Income Insurance have all economic approach and intend to make the farmers self-sufficient. Regarding irrigation problems the Water Protection Program has been presented in the last section.

As a part of the Green-Custom-Free Act which has been explained before, TPI is obliged to cooperate with the farmers who have new ideas about the technologies necessary to enhance the quality/quantity of the farms. The suggestions will be appealed to the Department of Green Cooperation and this department together with the Department of Green Research will write a report to the TPI main board on their technical idea about the farmer suggestion. The final decision will be made in the board to import the technology under the Green-Custom-Free Act or to find national factories. Regarding the Farm-Income-Insurance in the guidelines the self-sufficient farmer who has been awarded can be a member of the Green-Owner-Board to solve farmers' problems with TPI.

Solar-Farm Project: This is another project to cut a considerable part of the farmers' expenditures. However, the initial capital to start such a project can only be realized if the Renewable Energy Organization and the government consider the high benefits it has for the entire Tehran with about 3000 sunshine hours in a year (Wikipedia, 2015). Instead of paying loans to the farmer to pay his expensive bills for agricultural uses, he can be extricated from all existing bills including electricity and heating by installing solar panels in the farms. This is the sustainable way of removing fossil fuels in the farms and start changing the climate change rate of Iran in the world. The second advantage is that the solar panels are used to create the power that the farmer sells back to the electric utility. Someone else uses the power he makes. So the farmer can be a producer of the electricity as well. The extra advantage that only the solar farms comprise and not the roof ones is that on the farm the panels can be put on the big motorized towers (Figure 7.23). The motors allow the panels to track the sun so they have higher electrical output. Moreover, the towers are arranged so they do not get shaded because shade reduces the output. The solar farms are the best sustainable energy producers for climatic status of Tehran.

Figure 7.23: Solar farm with motors to increase the electricity output

Source: http://convergence-energy.com

Soil Improvement Program: Soil does not have to be washed or blown away for its productivity to be lowered. Through improper soil and water management, a soil's properties may be altered so that its fertility is seriously reduced or lost for good. This is a cooperative program between the TPI, the Soil and Water Research Institute and the farmers. At the first step the low-quality farms will be distinguished and presented in another map by TPI. The farmers or owners of these parcels will be invited in a meeting with the Department of Green Research and the Soil and Water Research Institute. The farmers discuss about their problems and the qualification of their cultivation and yield during the recent years. According to the technical knowledge of these two institutes, the new methods/technologies to improve the soil and yield will be discussed and selected.

During this program it will be checked that the three main nutrients-nitrogen, phosphorous, and potassium-are essential to healthy plant growth and try to use the organic fertilizers like horse manure which are rich in these. It has to be ensured that the trace nutrients -iron, boron, copper, manganese, molybdenum, zinc- are also added. Mycorrhize is a type of fungus that helps plants to absorb more water and nutrients and has to be tried as well. Moreover, worms which feed on organic matter and then disperse it through the soil are great at speeding up the composting process (http://www.dummies.com, 2015); therefore, all these factors and more have to be checked one by one by the two institutes and the farmer to increase the soil fertility. The TPI team supervises the process every 2-5 months to guide the farmers with further suggestions.

The next important criteria which have caused green land loss are concerning the socio-cultural educations. The programs here are different from the ones in region 1. They have another social level and intend to solve a part of the economic problems of the residents too.

Strengthening-18-Labor: This is a program which tries to use the local labor and occupational characteristics of the region in the direction of improving the agriculture. Due to the high unemployment rate in the region, TPI is ought to use the local residents for its constructions, civil works and workshops. As mentioned before, apart from fixed members of TPI, there are extra temporary half time jobs for the special events and when several parallel plans/projects have to be accomplished. In region 18, TPI is the subject to hiring the local residents and be the entrepreneur. Since the main occupations of the region are vehicle drivers, assemblers and operators, TPI is ought to use these potentials in the maintenance, transportation and installation tasks regarding TPI projects. Moreover, TPI will get help from the residents who are working in the health sections to work during the weekends in the health workshops. In this way, the TPI will be known by the residents and they consider themselves as the members of this institute.

Green-Point-Meetings: These points have been explained in region 1 for TPI connection with the owners. However, in region 18 due to the lack of the green spaces and parks, the new locations for these meetings have to be defined. In the beginning, before the recommended parks have not been founded, the small local parks, the mosques and the religious centers will be used for these meetings. Since these places are active face-to-face points for the residents of region 18, they are suitable places for gathering all the residents and organizing the meetings. Fridays which is the meeting day is the religious day as well, when all the Muslims should pray together

in the mosques. Since Islam supports farming and emphasizes on cultivating the trees in Quran, the religious leaders can be very effective in this region. Obviously, TPI needs a close cooperation with the Center of Supervision on Mosque Affairs.

Sustainable Workshops: Many different workshops are included in this program. Region 18 residents need to enhance their knowledge on the health problems regarding the air pollution, the importance of the farmlands and trees, climate change, national production and self-sufficiency. These are different subjects which will be discussed and processed in the separate workshops. TPI has to categorize the workshops according to age and start with the schools. The competitions for children will be held as explained in region 1. Parallel to schools the Green-Point-Meetings have each month one subject which will be discussed in four parts on Fridays in the mosques or the parks.

The non-G zones in the Detailed plan which have been explained in the beginning of this chapter have to absolutely be substituted by the green lands categories introduced in this research. Otherwise, Tehran will lose an extensive part of its farmlands in a very near future. Moreover, the Detailed plan has recommended to remove the factories in the region; in spite the existing economic issued of the residents, the economic compensation for this change has not been presented. In this research it is recommended to change the type of the factories adjacent to the farmlands. They should be gradually replaced by the food/dairy products or light industries compatible with the agricultural uses.

Region 18 needs more the socio-economic approach to solve the preservations issues whereas region 1 has to be provided with more socio-cultural issues. It is more likely that there will be more revenues in region 1 from the workshops and events with expensive fees than in region 18. As it has been mentioned before, The Green Bank money has to be distributed among all the regions to bring back the balance and the social justice for the whole system.

7.9 Proposals in region 2 according to the priority weight

Region 2 has two different parts with respect to the socio-economic qualifications and the urban spatial organization. The Pardisan Park in the center which extends from west to east is the boundary (Chapter 5).The north part is more similar to region 1 and the south part resembles more to region 18 but it does not comprise farmlands as region 18 does. This immigrant-region has received the immigrants more in the middle to northern parts where richer people than southern parts are located. In general, the emotional connection to the place is lower than in region 1. Here, the socio-economic programs with the women and the old local residents are not expected to be as successful as in region 1. The employed women are more than in region 1 and it is very hard to find the old generation living in this region for more than 40 years. However, in the very northern parts around the rural cores along the river-valleys these people are likely to be found.

Thus, some of the socio-cultural programs in region 1 can be applied in region 2-north as follows: the Park-Participation Program, The Green Point Meeting, the Owner Meeting, People-Projects-Tehran Gathering, TPI at schools and Green Woman Community. The Green-Owner-Board has to be completed by the owners of region 2 as well. In the region 2-south the Sustainable Workshops explained in region 18 and the Green-Point-Meetings in mosques/parks will be implemented.

River-Valley Program: The most important green zone of region 2 which has to be separately taken into consideration is Farahzad which has a valuable old rural texture (Chapter 3 and 5). These parcels will be selected and TPI works on them in a separate map individually as a “Special green preserved zone”. All the gaps between the green parcels have to be green to keep the green network connectivity of the zone. TPI has to distinguish the very old houses and places of the zone and work together with the Iran Cultural Heritage and Tourism Organization to take them under the heritage preservation.

Any construction or sub-division is strictly forbidden and the green parts of any parcel in the Green Archive are the subject of the preservation as described in the Tehran Preservation Act guidelines. This means that the owner can only build in the built-up part of the parcel and the green/open part marked in the ecological plan of TPI has

to be preserved. If the owner wants to construct in the building part the construction rules[1] are as follows: 10% occupancy rate, 15% building density in 1.5 floors. Since the recommended building densities in the Detailed plan cannot be accepted by TPI and it has covered many green lands with non-G zones, in this case they are being replaced by the new regulations. If the owner wants to use the extra building density with the same occupancy rate, he has to enter the donation system explained in Act. The occupancy rate which determines the surface area of the land under the construction has to be fixed and unchangeable. The donated part will be used by TPI to connect the green network and prevent disperse, fragmented green lands.

In order to compensate the owner's rights, the "Green Right"[2] is given to the parcels in this zone as well. In addition, any eco-tourism projects, gardening museums, flower exhibitions, art exhibitions, wedding salons and restaurants are allowable in the building part of the parcels. In the case of donation the same activities can be accomplished by TPI in the donated part with 7% occupancy rate only if the share comprises a low-quality soil part. This part has to be previously marked as low-quality soil in the soil map and has to be submitted by the Water and Soil Research Institute. In addition to the internal police supervises the procedure. The Parks and Green Space Organization supervises TPI regarding the green parts of the donated parcels in Farahzad. It sends its supervisors annually to check the quality of the preserved part that TPI has received by donation. In the case of any fraud, the case can go to the Supreme Court and the ownership will be given to the park organization to make park instead.

Except the close participation plans explained in the beginning of this part, the Department of Green Surveillance has to conduct annual check on the green texture quality of the "Special green preserved zone". According to TPA, if the quality/quantity has decreased, this department has to present the owner to TPI and try to find the reasons. If it stems from the water problems, TPI will help the owner to provide enough water to irrigate the green space. However, the water problems will separately be taken into account by the Water Protection Program explained before. Any other reason which has caused green quality degradation, directly or indirectly by the owner has to be solved as follows: he has to cultivate the double number of the destructed trees in the place TPI determines. The owner cannot sell his property before TPI confirms that he has cultivated the trees.

Green-New2-workshops: The last but not the least on the AHP list is to work on the immigrants. TPI has hold workshops which is open to everyone, especially the new residents of region 2. These workshops have two goals; first one is to promote TPI and its aims, sustainable development importance and preservation facts and figures and the second is to find the new immigrants and make a connection with them. The registered data on immigrants might not be complete enough for this program. Thus, TPI has to know these people through the workshops. The ultimate goal is to form the NGO called "Region 2 for Green" which tries to strengthen the emotional connection of the residents, immigrants and non-immigrants to the region and its nature.

The success of the suggested programs and plans in the regions can only be ensured if these conditions are fulfilled: they ought to be reviewed regularly and the outcomes have to be reported to evaluate the relative success; if the direction or approach is not right, it has to be refined and the mistakes have to be overcome. People's ideas have to be asked in a regular voting or local questionnaires to increase the people's participation.

7.10 Suggestions for the new municipality revenues

Since many of the problems which end up in green lands destruction in Tehran stems from the issues in the municipality revenue system, in this part a brief set of suggestions will be presented to make the revenues less dependent on the green lands and more sustainable for the future of the city. Moreover, the results of the AHP model show the high importance weights of several criteria which directly or indirectly are related to this subject.

It has to be emphasized once again that according to the "Tehran Preservation Act 2015" the land conversion and the density sale in the TGR of TPI is strictly forbidden. Similar to all the municipalities in the world, Tehran

[1] This is the recommendation of Baft-e-Shahr Consulting Company for this region which has been used in this research as well.
[2] Explained in region 1.

municipality has to find a new tax system based on the people's real income and the revenues from the constructions. The exact data is very hard to determine because it is not registered but it can be estimated according to the market prices and the average local land price which are reported by the Housing Department of the Road and Urban Development Organization. The law gives the permission to the municipality to present the new creative taxes to take the city in balance and implement the social justice. As an example the high-rise resident tax which has been explained can be used to cover many costs of the city.

The municipality has to obtain more extensive, clear, actual and real data on the residents and the city. In order to perform any new tax system or financial program the basic data base is extremely crucial. Therefore, in the first steps it has to cooperate with other organizations to complete its data or invest mainly in updating its equipments and knowledge in this field. In the recent years, ICTO[1] which is a part of the municipality has enhanced its technical knowledge and technology considerably and can be an effective element to fulfill this task. As an example, the high resolution aerial photos for all Tehran are one of the useful outcomes of this organization. To achieve this goal, the municipalities have to become the local authorities in practice and not just in theory. Tehran needs less centralized government to have more power in the regions and to solve the local problems more precisely and according to the region characteristics and potentials. Moreover, "the universal experiences show that the less centralized cities have proposed new creative programs to cover their expenditures (Hashemi et al., 2010, p.520).

The local taxes have to be organized according to the type of the service provided by the municipality for the residents. The financial status of each family has to be taken into consideration precisely. Only in this way can the social justice be mutually implemented. The municipality approach has to be different when it is presenting a service which has positive externalities or a merit good or a public good. These have to have different tariffs and require a deep and detailed data on the city. These tariffs have to take into consideration the final long term expenses that a service brings in for the municipality. Some existing taxes have to be shared with the municipality; it has to have a share of taxes on the goods and services and also taxes on companies' incomes. The annual renovation taxes which are currently gained by the municipality are not based on the real market price; therefore, they need to be updated and use the real data as well (Hashemi et al., 2010, p.523-533).

Recently, the VAT[2] has been passed in the Iran parliament and is being implemented in many fields and trades. The municipality can use VAT in its new programs and try to solve the problems it has in financial terms with the government.

The tax gained by the municipality has to have a stronger legal power and the responsible people have to implement the enacted taxes more seriously. Only 30% of the registered taxes are being paid and the municipality does not hire enough staff to pursue the documents (Hashemi et al., 2010, p.530). The annual renovation taxes which is according to law the financial resource for the municipality is being extensively ignored by the residents and is the best example for this fact.

Car taxes in Iran have to be reconsidered. They have to be raised according to their fuel, air and sound pollution, motor capacity and power and the age of the car. Since many families have more than 2 or 3 cars, the number of cars that a family or a person owns has to be taken into consideration as well. Moreover, the new imported cars already tariffed with 100% custom tax and belonging to the super rich must have special tariffs. Generally, however, these tariffs should not be in a way that is to discourage the less polluted cars, and a fair amount has to be calculated (Abdolah Milani, 2010, p. 597).

The polluting companies are subject of the tax system which compensates the air/ sound pollution they cause. The municipality can develop a special program to classify the companies and factories according to the pollution standards and charge the ones which are polluting. It has to have different classes and needs to be a progressive system.

[1] Information, Communication, Technology Organization
[2] Value Added Tax

Another field is that of the private investments and the cooperation within the city projects which can be a constructive resource to cut some expenses. This can be in any phase of the project such as construction, design, purchase and ownership.

Another resource which can be used are the barracks. According to the law, the barracks have to go under the management of the municipality. The municipality can use these open green parcels to implement the beneficial projects such as sport complexes, restaurants, hotel complexes and other green leisure-tourist activities. It has to be highlighted here that the construction regulations which are very strict in these parcels have been explained in region 1 proposals. Thus, municipality has to use the existing building and try to find the consistent activity that can be easier adjustable to the parcel.

The other point that is the resource of finance for many municipalities is their specialized knowledge. The municipality has a unique type of technical knowledge about the city along with the new soft-wares and data base which can be very useful for several organizations. It is obvious that the organizations rarely need the raw data; the municipality has to create the new data sets by synthesizing its available data which can be useful for the certain goals of an organization. As an example it can use the thermal photos to distinguish the cracks in the power lines under the ground[1]. This will cut the enormous costs of the deep excavations that different organizations have to endure to check the pipes or power lines. The municipality has to be creative in this field and try to offer scientific-technical projects to the organizations.

Recently, the municipality has started to reduce the unsustainable revenues and be more focused to find sustainable ones. For this matter it has organized several conferences with the UN-Habitat support with the title “Municipality Finance Conference”. Therefore, the suggestions mentioned above can only be a complementary component. It has to be highlighted here that apart from any program followed by the municipality, the government has to organize a clear financial budget to support the municipality. This resource has to be passed in the parliament annually similar to any budget allocation.

[1] This project has been discussed in the municipality of Essen.

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Organizations

1. Aban Consulting Company
2. Ammod Consulting Company
3. ATEC Consulting Company, Department of Urban Planning
4. Avers Consulting Company
5. Baft-e- Shahr Consulting Company
6. Game-e-ma Consulting Company

7. Iran Communication and Technology Organization (ICTO), Tehran Municipality
8. Ministry of Roads and Urban Planning
9. Naghshe-e-Mohit Consulting Company
10. Parsoumash Consulting Company
11. Paysa Consulting Company
12. Saravand Consulting Company
13. University of Tehran

Questioning/ Interviews/ Consultations and intellectual helps

Iran

1. Dr. Esfandiar Zebardast, University of Tehran
2. Mr. Samad Zoueshtiagh, ATEC Consulting Engineers Company
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14. Mr. Namazi, University of Tehran
15. Dr. Nourian, University of Tehran
16. Dr. Hanachi, Ministry of Roads and Urban Developments
17. Mr. Falahatpishesh
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